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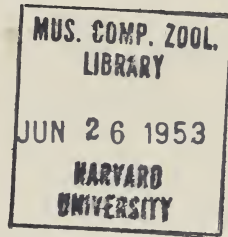


TABLE OF CONTENTS

| | |
|--|----|
| Three New Ants Related to <i>Strumigenys louisianae</i> Roger. <i>W. L. Brown, Jr.</i> | 1 |
| Observations on the Reproduction of the Giant Cockroach, <i>Blaberus craniifera</i> Burm. <i>W. L. Nutting</i> | 6 |
| Nemestrinidae (Diptera) of Iowa and Missouri. <i>J. Bequaert</i> | 14 |
| On Flanders' Hypothesis of Caste Determination in Ants. <i>E. O. Wilson</i> | 15 |
| Two New Species of Water Beetles from Florida (Coleoptera: Dytiscidae). <i>F. N. Young</i> | 21 |
| The Biology of <i>Brachyanorpa</i> (Mecoptera). <i>F. M. Carpenter</i> | 28 |
| Two New Oregon Chilopods of the Order Geophilida. <i>R. V. Chamberlin</i> | 37 |

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No. 1

THREE NEW ANTS RELATED TO *STRUMIGENYS LOUISIANAE* ROGER¹

BY WILLIAM L. BROWN, JR.

Museum of Comparative Zoology, Harvard University

In this time of high printing costs, the difficulty of publishing in one large work the results of my studies on the ant tribe Dacetini has forced me to break up what would otherwise be a revision in one piece into many smaller treatments. It is hoped that, with the publication after each large natural group of a concise key and other general information, the effect of a revision within the same covers will be approached.

Below are described three new species closely related to *Strumigenys louisianae* Roger, the latter being a common and well-known form ranging from Tennessee and Arizona south through the West Indies and Central America and reaching Bolivia and northern Argentina. *S. louisianae* has been known under several names in different parts of its range (*S. bruchi* Forel, *S. infidelis* Santschi, *S. eggersi cubaensis* Mann and *S. louisianae*, various subspecies and varieties), but all of these names are treated as synonyms in an extended discussion of this form at present in press. A distributional peculiarity of *S. louisianae* seems to be pointed up by the lack of records from the rainforest areas of the Amazon-Orinoco Basins and from the extensively collected Panamanian localities centering on Barro Colorado Island.

The descriptions given are all strictly comparative ones

¹Published with a grant from the Museum of Comparative Zoology at Harvard College.

drawn against *S. louisianae*. Relationships to other species have not been overlooked, however, as each of the three forms has been compared with all other neotropical species of *Strumigenys* known to me, both described and undescribed, except *S. fusca* and *S. unidentata*, two species to be placed among the *species inquirendae*.

The measurements given are stated in the way standard in recent publications dealing with the dacetine ants. Abbreviations: TL, "total" or synthetic aggregate length of body, including mandibles; HL, maximum measurable length of head proper; ML, exposed length of mandibles; WL, (Weber's) diagonal length of alitrunk, lateral view; CI, cephalic index, or maximum head width expressed as a percentage of HL; MI, mandibulocephalic index, or exposed length of mandibles expressed as a percentage of HL.

Material studied originated from, and is redeposited in, the W. M. Mann and National Museum Collections, United States National Museum (USNM); Borgmeier Collection, Petropolis, Brazil; series are also placed by exchange in the Museum of Comparative Zoology, Harvard University (MCZ). Thanks are due Father Thomáz Borgmeier, Dr. W. M. Mann and Dr. M. R. Smith for the privilege of examining the above-mentioned series.

All three species, like *S. louisianae*, belong to the nominate subgenus of *Strumigenys*.

Strumigenys clasmospongia new species

Holotype worker: TL 2.57 mm., HL 0.60 mm., ML 0.39 mm., WL 0.58 mm., CI 74, MI 65.

Similar to *S. louisianae*, but differing in its larger, distinctly more slender body and relatively much longer mandibles, and also in the following details:

(1) Promesonotum with a fine but distinct median longitudinal carinula; lateral carinuliform margins also more distinct, and on each side of the mesonotum forming a low, rounded translucent flange; posterior to each of these flanges is a second smaller, but similar flange at each posterior mesonotal corner. Homologous, but much less distinct flanges may sometimes be seen in *S. louisianae* workers.

(2) Metanotal groove as distinct as in *S. louisianae* or slightly more so; posterior mesonotal region a bit more strongly concave and slightly more distinctly constricted.

(3) Petiolar node with a more slender peduncle and the anterior face not so strongly obliquely depressed, the summit rather evenly rounded in profile seen from the side; node only slightly broader than long seen from above.

(4) Dorsum of postpetiole for the most part smooth or nearly so, definitely shining. Gastric dorsum at base with a few feeble costulae, basal tergite only feebly reticulate (covered with a whitish dried film possibly representing a secretion) and with anterior part subopaque, but sides and posterior half moderately but definitely shining. Sculpture over entire body a trifle weaker than in *S. louisianae*.

(5) Pilosity in general a little less abundant and conspicuous; ground pilosity vestigial on alitruncal dorsum. Color ferruginous.

Holotype (Borgmeier Coll.) taken at Petropolis, State of Rio de Janeiro, Brazil; "gesiebt. Nr. 5884" (T. Borgmeier leg.)

Paratypes: 5 workers (Borgmeier Coll., USNM, MCZ) with data as for holotype. TL 2.54-2.76 mm., HL 0.60-0.65 mm., ML 0.39-0.41 mm., WL 0.58-0.62 mm., CI 71-76, MI 63-66.

***Strumigenys producta* new species**

Holotype worker: TL 2.91 mm., HL 0.65 mm., ML 0.45 mm., WL 0.70 mm., CI 81, MI 69.

Very similar to *S. louisianae*, but larger, more slender, and with much longer mandibles. Dentition as in *S. louisianae* and *S. clamospongia*, that is, with a single small preapical tooth and two acute intercalary denticles to the apical fork. Also the following differences from *S. louisianae*:

(1) Propodeal spines more slender and acute, rather strongly elevated, divergent, longer than the distance between the centers of their bases.

(2) Gastric tergite I with fine basal costulae extending

1/3 its length, remainder of its surface only very feebly and superficially reticulate, definitely shining.

(3) Petiole slender, with a long, slender peduncle and subglobose node; posterior spongiform collar vestigial; cariniform.

(4) Ground pilosity of alitrunk reduced and mostly inconspicuous. Color light ferrugineous; appendages, etc. and base of gaster lighter, more yellowish.

Holotype (Mann Coll., USNM) one of a series of 15 workers in the type series, taken at Rurrenabaque, Rio Beni, Bolivia (W. M. Mann leg.)

Paratypes: (USNM, Coll. Borgmeier, MCZ) Remaining 14 workers of type series, same data. TL 2.85-3.06 mm., HL 0.65-0.70 mm., ML 0.45-0.48 mm., WL 0.69-0.74 mm., CI 78-82, MI 69-70. Color varying from yellowish- to medium-ferrugineous.

Strumigenys mixta new species

Holotype worker: TL 2.32 mm., HL 0.54 mm., ML 0.31 mm., WL 0.54 mm., CI 83, MI 57.

Differs significantly from *S. louisianae* only in the following details:

(1) Inner mandibular border with an extra minute denticle slightly basad of the apical third of the ML.

(2) Pilosity decidedly narrower and less conspicuous, especially on the posterior cephalic dorsum. Paired, outstanding hairs, one on each lateral occipital border, each humeral angle and each side of the mesonotum are all finely flagelliform, whereas in *S. louisianae*, the lateral occipital and mesonotal hairs are stiff and spatulate towards their apices.

(3) Metanotal groove completely or very nearly completely obsolete; in profile from lateral view, the posterior alitruncal dorsum continuous in outline, not interrupted by the notch at the metanotal groove as in *S. louisianae*.

Color light ferrugineous yellow.

Holotype (USNM) one of 15 workers taken at Escuintla, Guatemala (W. M. Mann leg.).

Paratypes: 14 workers from type nest series, same data

as for holotype, and 5 workers from orchid plants (*Cattleya bowringiana*) shipped from San José, Guatemala and intercepted in U.S. Plant Quarantine at San Francisco, California (SF 20739 Supl.; 46-5348). Deposited in USNM and MCZ. TL 2.14-2.49 mm., HL 0.51-0.59 mm., ML 0.28-0.32, WL 0.51-0.60, CI 80-84, MI 54-60. The Escuintla (type nest) series is made up of mostly smaller, yellow individuals, while that from San José contains workers mostly in the upper part of the size range given and medium ferruginous or deep burnt-orange in color. Means of dimensions, but not of proportions, differ slightly, but there is also an absolute overlap. The color difference is not considered taxonomically significant in the face of similar variation seen in many other dacetine species. The name *mixta* refers to the intermediate characters, seemingly linking *S. louisianae* and *S. emeryi* Mann, but also distinguishing this species from both.

OBSERVATIONS ON THE REPRODUCTION OF
THE GIANT COCKROACH,
BLABERUS CRANIIFERA BURM.

BY W. L. NUTTING

Biological Laboratories, Harvard University

In his *Embryology of the Viviparous Insects*, H. R. Hagan (1951) cites nine species of roaches recorded as exhibiting some type of viviparity, or oviparity approaching viviparity. Chopard (1950) and Van Wyk (1952) have furnished two additional examples of viviparous blattids. Much of the evidence for viviparity has been indirect; that is, it has been based on dissections of gravid females, while in scarcely half the cases has the birth process actually been witnessed. Among the species mentioned by Hagan are the West Indian *Blabera fusca* Brunner (Saupe, 1929), and a Bolivian *Blabera* species (Holmgren, 1903). (*Blabera fusca* Brunner can probably be referred to *craniifera* Burm. according to Rehn and Hebard (1927).) Over the past seven years I have had the opportunity to observe rather closely a flourishing culture of *Blaberus craniifera* Burm., originally started from Florida specimens by Prof. C. T. Brues. (This roach is limited to Cuba in the West Indies and ranges from southern Mexico to British Honduras on the mainland; it has undoubtedly been introduced to Key West from Cuba.) During this period I have found newly hatched nymphs dozens of times, but only recently have I observed parturition itself. Before recounting this event, it seems appropriate to include available information on mating, the little-known spermatophore, and other relevant details on the reproductive habits of this large laboratory roach.

Blaberus is rarely active during the daytime, even in the laboratory, and I have never seen courting behavior. However, Saupe (1929) described the one case of love play and copulation for *B. fusca* which he observed during daylight. The actions were generally much like those detailed for

some of the more common roaches (see Roth, 1952), except that no dorsal glands are known which attract and engage the female as in *Blattella*. The male vibrates his antennae and goes through brisk quivering motions, sometimes raised up on his legs. After contact stimuli from the interested female he raises his wings, while the female advances over his abdomen as far as his raised wings to the "female superior pose". As the male makes contact with the female's genitalia, they simultaneously turn in opposite directions to complete copulation in the "false-linear position" which is typical for the roaches. The pair observed by Saupe remained together for 80 minutes, but I have noted many pairs together for four hours and more which is much longer than is usual for most roaches.

Many texts list the occurrence of spermatophores in certain members of the Thysanura, Odonata, Neuroptera, Lepidoptera, Coleoptera, and several subgroups of the Orthoptera. Until recently, oddly enough, it was not generally known that this method of sperm transfer is also used by at least some of the blattids. Zabinski (1933) first described and figured the spermatophore for *Blatta orientalis*, while Qadri (1938) reported some conflicting observations on spermatophore formation for the same species. Hagan (1941) mentioned the genital pouch as a receptacle for the spermatophore in *Diploptera*, but did not describe it. The spermatophore of *Periplaneta americana* was described and figured in position by Gupta (1947). The formation of the spermatophore of *Blattella germanica* is described and discussed by Khalifa (1950). Roth (1952) presented notes on the spermatophores of *Blattella*, *Blatta*, and *Periplaneta*. Recently Van Wyk (1952) described the spermatophore of *Leucophaea maderae*. The present observations on *Blaberus* now make a total of five subgroups of the Blattaria which are known to form spermatophores. This strengthens Khalifa's presumption that spermatophores are of general occurrence among the roaches.

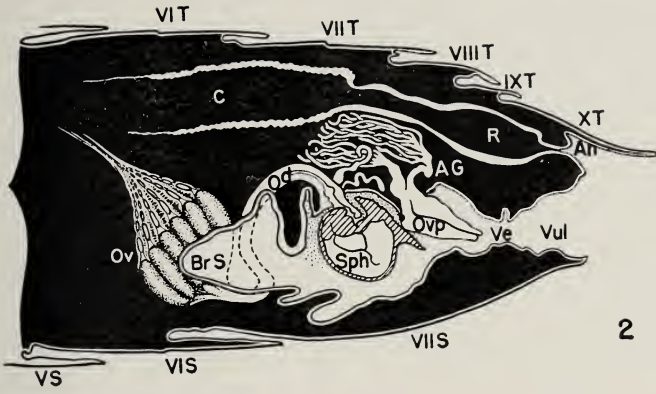
Figs. 1 and 2 show the position of the spermatophore (Sph) in *Blaberus* shortly after copulation. The freshly deposited spermatophore is a tailed, pearly-white spheroid, about 3.5 mm. in diameter. A clear, jelly-like mass fills

the vestibule (Ve) and cements (stippled area) the spermatophore into the genital pouch. According to Qadri the spermatophore of *Blatta* contains a number of sperm capsules, while Khalifa and Van Wyk described two sperm sacs in those of *Blattella* and *Leucophaea*. In *Blaberus* the spermatophore is irregularly divided into a small and a large compartment, while two sperm ducts lead from the larger one to oppose the spermathecal orifices. Whereas most of the roaches previously noted have not retained their spermatophores longer than 24 hours before dropping them, one *Blaberus* female was noted to retain her spermatophore intact for five days, when on the sixth day a mass of chalky fragments and greyish jelly was observed in her genital pouch.

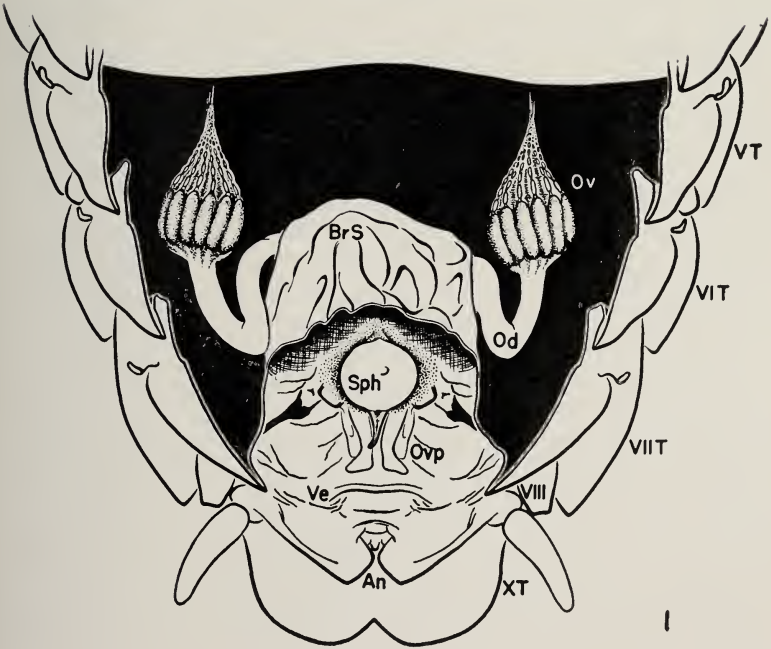
As in the other roaches which retain their eggs for a considerable time, the oötheca resembles a thin, transparent plastic bag drawn tightly about the eggs. It is quite smooth and, as it varies in thickness, a dull ochraceous to a bright chestnut in color. A point which has previously been overlooked in *Blaberus* is that the oötheca is not complete, so that the micropylar end of each egg is plainly visible through a slit usually wider than one egg. The extremely delicate oötheca of *Diploptera* as described by Hagan, never covers more than half of each oöcyte, and may not even cover the older eggs. Although *Blaberus* does not approach this extreme, the pro- and mesothorax of each embryo are virtually free of the oötheca shortly before birth. This open type of oötheca may be of some importance to embryonic respiration within the brood pouch as suggested by Hagan. The elaborate arrangement of air tubes through the keel of the conventional armored roach oötheca (Lawson, 1951)

EXPLANATION OF PLATE 1

Fig. 1. *Blaberus craniifera* Burm. Ventral dissection of female reproductive system showing spermatophore (Sph) cemented (stippled area) into the genital pouch over the gonopore. The posterior ventral wall of the genital chamber has been removed. Fig. 2. Sagittal section through region shown in Fig. 1. AG, accessory gland; An, anus; BrS, brood sac; C, colon; Od, oviduct; Ov, ovary; Ovp, ovipositor; R, rectum; S, sternite; Sph, spermatophore; T, tergite; Ve, vestibule; Vul, vulva.



2



1

NUTTING — BLABERUS CRANIIFERA

would certainly be unnecessary, if not actually impractical here.

One of the largest oöthecae I have seen contained 45 eggs and measured 8 x 35 mm., while an unusually small one containing 23, probably from an old female, measured 4 x 16 mm. The average number of eggs found in 14 oöthecae was 36.4. Saupe (1929) gave an average of 23.25 eggs for 8 oöthecae, ranging from 11 to 38 per oötheca in *B. fusca*. Stewart (1925) reported an oötheca $\frac{1}{4}$ x $1\frac{1}{2}$ inches containing 44 eggs from a specimen of *B. cubensis* Saussure. (Rehn and Hebard (1927) refer this species to *B. discoidalis* Serville.) Two oöthecae of the Central American *B. trapezoideus* Burm. measured 7 x 35 and 4.5 x 31 mm., and contained 40 and 41 eggs respectively. *Diploptera*, which has been more thoroughly studied than any of the viviparous roaches, exhibits a pseudoplacental type of viviparity and forms an oötheca normally containing but 12 eggs. All other known viviparous roaches produce many more eggs at a time, the numbers per oötheca generally falling within the limits reported for these three species of *Blaberus*.

While in the brood sac, all the eggs in an oötheca have the micropylar ends directed toward the left. The smallest eggs found in newly formed oöthecae measured 1.7 - 2.0 x 4.5 - 5.0 mm.; the largest, shortly before hatching, 2.5 x 8.2 mm. In the young germ band stage the pleuropodia resemble short, thick-stalked, immature mushrooms, and project back to the posterior margin of the second abdominal segment. In the chitinized embryo, shortly before they are resorbed, they appear as long, thin-stalked mushrooms extending to the middle of the third abdominal segment. They consist of a base and bulb only; there is no evidence of any pleuropodial extension as found in *Diploptera*. The eggs contain a large amount of yolk, and a considerable amount is present shortly before hatching. In the absence of any embryological studies on *Blaberus*, little more can be said concerning embryonic nutrition; it does not seem likely that the mother provides any more than the original yolk.

Many times I have seen females with a newly formed

oötheca protruding about two-thirds of its length from the brood sac. Some of these females were segregated, and their oöthecae were usually completely returned into the brood sac within a short time. This act apparently signals the completion of an oötheca and the beginning of the incubation period, as has been observed in *Gromphadorhina* by Chopard (1950). Neither the duration of gestation nor the span of female reproductive life is known for any of the species of *Blaberus*, although the former may last for more than two months. Females sometimes discard an oötheca; this has occurred most notably after the roaches have been disturbed and handled during cage-cleaning. Except in two cases noted below, none of these oöthecae has been known to hatch.

Recently a relatively inactive female was found with about half the length of her oötheca extruded from the brood sac. At least the pro- and mesothorax of each visible embryo were free of the oötheca. The ensuing events of hatching were observed under a low-power dissecting microscope. All of these embryos were rapidly swallowing air, and the bubbles could easily be seen passing through the head capsule into the enlarging crop. Within 2 or 3 minutes the embryonic cuticle on one individual had split; after 60 to 90 seconds, with some side to side struggling, it was free. Although the abdominal movements of the female indicated that she was trying to expel the oötheca, she was unable to extrude more than three-fourths of its length. I therefore removed the egg case, and within 10 minutes all but four unfertile eggs had hatched.

On becoming free the embryos gradually stopped swallowing air; at this point they were cylindrical and about 10 mm. long. They began telescoping their abdominal segments and within a few seconds they had assumed a flattened roach-like appearance measuring about 7 mm. long. The air is probably expelled through the mouth. The young roaches do not leave the mother but swarm over the oötheca practically consuming it in a short time. Saupe (1929) suspected the mother of devouring the oöthecal remains. A degree of maternal solicitude is exhibited by this roach, for many times I have observed the female to remain

motionless for an hour or more with her unpigmented brood clustered around and beneath her body. The nymphs are completely pigmented in about 6 hours. I have recorded the next molt as occurring within 15 to 36 days for four different broods.

Although deposited oöthecae generally do not hatch, a mature one, picked up two days after the cage had been cleaned, did hatch after considerable handling. While examining another oötheca six days after its deposition, it was noted that the embryos were swallowing air. Slight pressure on the oötheca while held between the fingers finally resulted in the successful hatching of 14 normal nymphs. Two more nymphs were obtained from this same oötheca upon considerable manipulation ten days after its deposition. On numerous other occasions mature oöthecae have been kept in humid petri dishes for two or three weeks without hatching. The hearts of these embryos continued beating until they finally died from mold or desiccation. These observations strongly suggest that the pressure exerted by the female on the oötheca during extrusion supplies the necessary hatching stimulus. Unless some such stimulus is applied to initiate the air-swallowing, mature embryos remain helplessly encased until death.

The fine line separating ovoviviparity from viviparity seems to be whether or not the embryos hatch before deposition. By strict definition, this single reported observation on the birth of *Blaberus* nymphs would qualify it as an ovoviviparous insect. Many more observations would be required to determine whether the female generally retains the oötheca while the majority of the embryos hatch; it appears to me quite impossible for the event to take place within the confines of the brood sac itself. Although this categorizing is relatively unimportant, the features which place this fine laboratory insect between the more common oviparous roaches and the viviparous *Diploptera* are worth noting.

The ovarioles have not been reduced in number (16 to 23 per ovary as opposed to 6 in *Diploptera*), and the accessory glands are not as highly modified as in *Diploptera*. Even though each oötheca contains a large number of eggs,

the period between oöthecae may be measured in weeks rather than in days as in *Periplaneta* (Gould and Deay, 1940). The brood sac is very large, and the development of the genital pouch approaches that of *Diploptera*. Lastly, the oötheca is soft, thin, and open, and is retained in the brood sac until hatching. In summary, the major modifications toward viviparity in *Blaberus* have occurred in the mother and not in the embryo.

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NEMESTRINIDAE (DIPTERA) OF IOWA AND MISSOURI. — A small collection recently sent by Mr. Jean L. Laffoon, at Iowa State College, contains a male of *Neorhynchocephalus sackenii* (Williston) collected at Sioux City, Woodbury Co., Iowa, June 10, 1949, by J. A. Slater and J. L. Laffoon. It was taken immediately above the mouth of the Sioux River, on top of the loess hills which border the Missouri River in western Iowa. Mr. Laffoon points out to me that this area contains some plants and animals ordinarily found only farther west. It is the first record for any of the Nemestrinidae in Iowa. Specimens of *N. sackenii* were also collected at Washington University Farm, 7 miles southwest of Clarksville, Pike Co., Missouri, by Mr. Robert A. Dietz, of the University of Tennessee. *N. sackenii* is now recorded from British Columbia and the states of Washington, Oregon, Montana, California, Idaho, Wyoming, Utah, Arizona, Colorado, New Mexico, Kansas, Oklahoma, Arkansas, Missouri, Iowa, Michigan, and Illinois. I have seen specimens from Huachuca Canyon, Cochise Co., Arizona, August 17, 1950 (R. L. Langston). It is remarkable that there are as yet no records from Mexico. — J. BEQUAERT, Museum of Comparative Zoology, Cambridge.

ON FLANDERS' HYPOTHESIS OF CASTE DETERMINATION IN ANTS*

BY EDWARD O. WILSON

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S. E. Flanders (1945, 1952) has recently advanced a hypothesis concerning caste determination in ants which has gained wide recognition. According to Flanders, the nutritive material available to the female embryo in the egg determines the developmental path it will follow as a larva, producing finally a queen or one of the worker subcastes. The available nutritive material is assumed to be a function of the degree of ovisorption, since this has been shown to be the basis of discontinuous variation in several terebrant Hymenoptera. The degree of ovisorption in turn is assumed to be a function of one or more environmental influences affecting the queen. One of the ways the environment can act is through its effect on the rate of oviposition, which is probably inversely related to the degree of ovisorption.

What appears to be the crux of Flanders' hypothesis is stated as follows in his 1952 paper: "Since the worker caste is characteristic of all non-parasitic ants, irrespective of the wide variation in the larval nutrition of the various species, it is evident that any trophic influence on caste formation must be made effective through an agency common to all ant colonies. Such an agency is most likely to consist of a set of conditions resident in the queen. Morphological differentiation would be initiated therefore prior to egg deposition."

* Dr. Flanders has recently published the paper read at the December 1952 meeting of the American Section of the International Union for the Study of Social Insects (*Scientific Monthly*, 76: 142-148, 1953). This contains an extensive elaboration of his hypothesis, with heavy emphasis on examples drawn from the terebrant Hymenoptera, but presents no new experimental evidence bearing on ants and does not take into account the objections raised by myself at the original reading and presented once again in the following paper.

From the onset this line of reasoning appears weak, since it is obvious that the environment of the ovary is by no means the only condition affecting individual development which is common to all ant colonies. Colonial organization and the details of individual postembryonic development are fundamentally the same for all ants and are amenable to the establishment of any number of physiological mechanisms controlling caste differentiation. To settle on one specific mechanism without supporting evidence is to engage in almost pure speculation. Since a great deal of new information bearing on this subject has been brought to light in the past decade, a reevaluation of Flanders' suggestions and of the literature pertinent to them is warranted at the present time.

One does not need to look far to find that Flanders' hypothesis is contravened by a considerable body of evidence, much of it resting in the literature. While it is possible that the differences in yolk content which are presumed to underlie caste differentiation may be so subtle as to escape the eye of the casual myrmecological observer, it still should be taken as significant that variation in egg size and content have rarely been recorded in the literature and then have been shown definitely not to correlate with caste differentiation (Eidmann 1931, Ledoux 1950). Some effort has actually been made to demonstrate caste differences at the level of the egg, as in the work of Bhattacharya (1943) on *Oecophylla smaragdina* (Fabricius), but with negative results. Direct evidence against the hypothesis may be supplied by the work of Ledoux (1949, 1950) on *Oecophylla longinoda* (Latreille). In this species the workers act as supplementary reproductives and can produce males, queens, and major and minor workers with equal facility. Two sizes of eggs are laid, averaging in length 0.6 mm and 1.1 mm respectively. The larger size yields males, the smaller, any of the three female castes. The fecundated female, on the other hand, lays eggs all of the same size, averaging 1.2 mm in length, from which proceed either workers (at least) or males. Ledoux has offered the logical explanation that the smaller worker eggs produce females and not males, as would be expected

from unfertilized eggs, because they are laid prematurely and at least some time before the first meiotic division. But whatever the explanation, the important point considered here is that workers can develop from eggs of either of the two different sizes, whereas queens develop from at least the *smaller* of the two sizes. While it is true that the size of the *Oecophylla* egg may not absolutely determine yolk content, yet it seems very probable that the differences in yolk content between two such markedly distinct egg sizes would greatly outweigh the very slight differences that must be assumed to determine caste in the worker-laid egg if Flanders' hypothesis is correct.

The preponderance of available evidence seems to indicate that the caste of female individuals is determined in the larval period, without regard to the original condition of the egg. The work of Wesson (1940), Goetsch (1937), and many others in the past half century has shown that larval feeding plays a major role; an excellent review of this work is presented by Light (1942-43). Gregg (1942) has shown that the major-minor ratio in colonies of *Pheidole morrisi* Forel affects significantly the ratio of these castes appearing in the brood, and he has offered as the simplest explanation that this condition originates through trophic influences, possibly ectohormonal, on the developing larvae. Recently, Brian (1951) has outlined his preliminary results from current work on caste determination in *Myrmica rubra* L. The threshold for queen-worker divergence is reported to be in the larval period; in order to attain queenness an overwintering larva must reach by a certain time a weight of about 6.5 milligrams. It must then race to reach another threshold in order to become a fully developed queen; if it fails, it ends its development abnormally small or as an intercaste. Ledoux (*op. cit.*) presents convincing evidence that in *Oecophylla longinoda* the threshold for queen-worker divergence is in very early larval life, while the threshold for major-minor divergence is at some time in the second larval stadium. In the work of both Brian and Ledoux it is especially noteworthy that larval nutrition and larval size are apparently the major factors involved.

The present writer (Wilson 1953) has shown that all stages of polymorphism in ants can be explained on the basis of simple or modified adult allometry and correlated changes in the frequency distribution of size. The greater part of the differential growth underlying this allometry must occur no sooner than the prepupal stage, when the gross adult form is laid down by the proliferation and deployment of the pupal hypodermis. Certain finer details of allometry may not become apparent until later at the onset of adult development. The allometric character of the castes is obscured in the case of complete dimorphism, or queen-worker and major-minor segregation, in which the intermediates drop out and the log-log allometric regression curves of the two castes become disaligned. Dimorphism can be explained simply on the basis of abrupt changes in the specific growth rates of the imaginal discs of various organs at critical sizes or under certain physiological influences, a phenomenon which has been demonstrated to be fundamental in the ontogenetic growth of many other groups of animals (Teissier 1934, Yasumatsu 1946). Queen-worker divergence, preceding in ontogeny the allometric differentiation of the worker subcastes, probably is initiated at a critical time by the fixing in the imaginal discs of one of two alternative specific-growth-rate potentials; this is attended by an approximate regulation of the course of larval development. A second threshold of this type may be introduced at a later stage of larval development in the case of major-minor dimorphism. As stated previously, the important specific-growth-rate potentials are completely expressed only at or after the onset of pupal development prior to the last larval ecdysis. This means that differentiation of female castes at all levels is probably a function of size, whether in the attainment of a threshold size in larval development, in the case of dimorphism, or in the relation of gradient allometric growth to the total size reached at the termination of larval development, in the case of the more elementary stages of polymorphism.

If an attempt is made to fit Flander's hypothesis to this concept, it seems to force the proposition that the nutritive

material in the egg determines caste by predetermining exactly the size reached by a larva at various stages of its development. Such a proposition would be wrong, of course, since it is a commonly observed fact that the growth of larvae can be changed greatly by simply varying the amount and kind of food supplied the colony. It appears to the present writer that Flanders' explanation has a good chance of holding only under certain conditions of complete dimorphism. It is not impossible that in extreme cases the critical developmental time mentioned above can be pushed back in ontogeny all the way through the larval period and to the embryonic period within the egg, so that the imaginal disc potentials are already fixed at the time of eclosion from the egg. On the other hand, ovisorption might exercise a subsidiary influence in caste determination by statistically affecting the *chances* of a larva attaining the important size levels during its growth; existing data on larval development are not complete enough to evaluate this particular aspect. Whether ovisorption ever actually plays these two roles remains to be seen, but at the present time this outstanding fact must be accepted: there is no direct evidence upon which to base such an assumption.

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TWO NEW SPECIES OF WATER BEETLES
FROM FLORIDA
(COLEOPTERA: DYTISCIDAE)*

BY FRANK N. YOUNG

The two new species of Dytiscidae described below were encountered during the course of the writer's investigations of the species comprising the genera represented in the Florida fauna.

The new *Hydrovatus* is remarkable in that it is apparently confined to the peninsular region of Florida and may represent an endemic form originally isolated on the Pleistocene Islands. Examination of the type of *Hydrovatus indianensis* Blatchley convinces me that it is not that species although the two are similar. The occurrence of "giant" forms within the limits of the populations of *H. pustulatus* Melsheimer and *compressus* Sharp respectively suggests the possibility that they may represent mutant or even polyploid species.

The new *Copelatus* has stood on our lists for many years as *C. debilis* Sharp, but a comparison of Blatchley's specimens with true *debilis* indicates that the two are distinct. The form is probably not restricted to the Florida Keys, unless those islands represent the remnants of a land mass more ancient than we now suspect.

***Hydrovatus peninsularis* sp. nov.**

DIAGNOSIS: A moderately large, dark colored *Hydrovatus* resembling in general *H. indianensis* Blatchley, but differing from that species in color pattern and in punctation. From *H. major* Sharp or *horni* Crotch it differs in lacking conspicuous sulci on the sides of the elytra. From *H. pustulatus* Melsheimer and *compressus* Sharp it differs in its

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larger size, different coloration, and in the structure of the male genitalia. Total length ranges from 2.9 to 3.1 mm.; greatest width from about 1.9 to 2.1 mm. Average size based on measurements of eight specimens about 2.98 by 1.96 mm. *H. compressus*, the only species so far taken in company with *peninsularis*, averages about 2.31 by 1.58 mm. *Peninsularis* may represent a form of *indianensis*, but that species is still so rare in collections that I have had no material available for comparison except the unique female type.

HOLOTYPE MALE: Form broadly oval, nearly hemispherical. Outline of body when viewed from above broadest at base of elytra, not much narrowed anteriorly, but narrowing posteriorly from the humeri with a slight sinuation near the middle of the elytra beyond which the elytra narrow again to the acuminate tips. Strongly convex above and below. Total length 2.92 mm.; greatest width 1.98 mm. Width at base of pronotum 1.81 mm.; width at apex of pronotum 1.13 mm.; length of pronotum at midline 0.76 mm. Length from base of prosternal process to apex of coxal lamina 1.43 mm. Width between eyes 0.73 mm. *Head:* Microreticulate with some irregularly spaced, moderately fine punctures. (Coarser punctures along inner margin of eyes and on front in usual position for genus.) Clypeus inconspicuously margined. Microsculpture of vertex with meshes regular and rather deeply impressed. *Pronotum:* Microsculpture much as on head. Punctuation much coarser than on head, coarse and dense along anterior and posterior margins but somewhat finer and sparser on disk and toward sides. Punctures at apex and base of pronotum with some tendency to coalesce to form vermiculate sculpture. *Elytra:* Microsculpture less deeply impressed than on either the head or the pronotum (surface appearing more strongly polished). Punctuation coarser than on pronotum and arranged in roughly regular rows or striae running from base toward apex. (Three striae of hair bearing punctures vaguely discernible on each elytron). Apices and lateral margins of elytra less densely and more finely punctate than disk. A number of coarse punctures extending posteriorly from the humerus of each elytron

apparently occupy the same position as the sulcus seen in *major* and *horni*. Below these punctures there is a vague longitudinal ridge above the epipleura. *Venter*: Metasternum slightly more coarsely and irregularly punctate than the elytra. Hind coxal plates with very large punctures separated from one another by less than their own diameter and in part confluent (punctures much coarser than those of elytra; about as coarse as those of elytra in *indianensis*). Two basal abdominal sternites with a few coarse punctures; other sternites with microsculpture but not conspicuously punctate (two basal abdominal sternites very coarsely and confluent punctate in *indianensis*). Terminal abdominal sternite mucronate but without a median ridge (with a blunt projecting ridge and not strongly pointed in the female type of *indianensis*). Epipleurae with some coarse, irregularly spaced punctures. *Anterior* and *middle tarsi*: Moderately strongly dilated. Anterior protarsal claw slightly broader and blunter than its fellow. *Genitalia*: Similar to those of *compressus* and *pustulatus*, but with the parameres more evenly rounded at the tips, and with the aedeagus with the constricted apical portion relatively longer, stouter, and less strongly curved down at the tip. *Color*: Head nearly uniformly reddish brown. Pronotum with disk dark reddish brown and the lateral margins lighter; base and apex somewhat darker, but no lighter cross-bar between them as in *indianensis*. Elytra dark reddish brown, each with a transverse sub-basal yellowish brown spot which reaches the lighter margin at the side but does not attain the suture, a postmedian yellowish brown spot, and the apices yellowish brown. Venter reddish brown with the metasternum and hind coxal plates darker. Color pattern similar to that of *indianensis* but differing in the narrower sub-basal spot and the larger postmedian spot, as well as in the lack of a light cross-bar on the pronotum.

ALLOTYPE FEMALE: Similar to the male but somewhat more regularly oval, somewhat darker in general color, the elytra less polished and with the anterior and middle tarsi less strongly expanded. Total length 2.93 mm.; greatest width 1.97 mm. Width at base of pronotum 1.62 mm.;

width at apex of pronotum 1.16 mm.; length of pronotum at midline 0.76 mm. Length from base of prosternum to apex of coxal lamina 1.48 mm. Width between eyes 0.78 mm.

VARIATION: Paratypes differ somewhat from the types in coloration and in the coarseness of punctation. The punctation of the pronotum in some is coarser, in others finer than in the types.

TYPE LOCALITY: Holotype and allotype from: FLORIDA: Alachua County, Lake Newman east of Gainesville, Sept. 27, 1939 F. N. Young. Paratypes from: FLORIDA: Alachua County, Bivan's Arm of Payne Prairie south of Gainesville, Feb. 1939 F. N. Young (4 ♀); Lake Wauberg near Micanopy, Apr. 30, 1938, F. N. Young (1 ♀); Polk County, Saddle Creek Canal, 1 mi. north of Bartow, Nov. 1, 1951 Ellis Lanquist (1 ♂); and Brighton (Okeechobee), June 16, 1929, P. J. Darlington Jr. (10 exs.).

LOCATION OF TYPES: Holotype, allotype and two female paratypes are in the University of Michigan, Museum of Zoology, Ann Arbor. One male paratype is in the collection of Ellis Lanquist at the Department of Biology, University of Florida, Gainesville. One female paratype is in the collection of H. B. Leech at the California Academy of Sciences, and another in the W. S. Blatchley collection at Purdue University, Lafayette, Indiana. The Brighton paratypes are in the Museum of Comparative Zoology (Type No. 29,018), Cambridge, Massachusetts.

Copelatus blatchleyi sp. nov.

1919 *Copelatus debilis* Blatchley, not of Sharp, Bull. Amer. Mus. Nat. History, 41 (4):312.

1932 *Copelatus debilis* Blatchley, not of Sharp, "In Days Agone . . .," Nature Publishing Co., Indianapolis, p. 293.

The *Copelatus* recorded by Blatchley from Florida (see above) represents a species resembling, but very distinct from *debilis* Sharp as represented by specimens from Texas, Mexico, and Central America. Blatchley (1932) states that his specimens were sifted from among dead leaves about 200 yards from tidal pools near the cemetery at Key West. He surmises that the species may be a

brackish water form, but from the situation cited *blatchleyi* will more likely be found associated with the ephemeral rain pools which form in the broadleaved evergreen jungle hammock associates of the Keys. It will probably also be found in the West Indies.

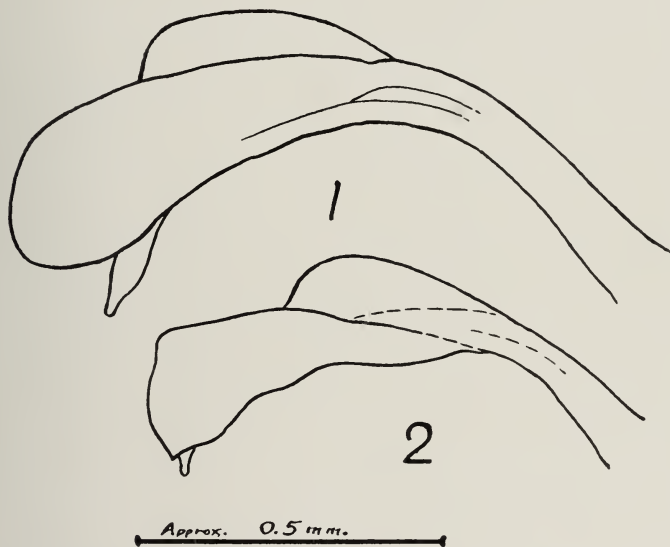


Fig. 1. Lateral outline of aedeagus of holotype of *Copelatus blatchleyi* from Key West, Florida. Fig. 2. Lateral outline of aedeagus of *Copelatus debilis* from Brownsville, Texas. (Both figures drawn to same scale)

Copelatus cubaensis Schaeffer (Jour. New York Ent. Soc., 16: 18, 1908) seems from the description to be very similar to *blatchleyi*, but is described as having a submarginal and six other striae on each elytron. A comparison of the male genitalia should help to determine the relationships of several forms which we now place in different groups almost entirely on the number of striae on the elytra. The genitalia of *debilis* and *blatchleyi* are of a similar type radically different from those of *glyphicus* or *chevrolati*. *C. chevrolati*, the only other *Copelatus* so far taken at Key West, is easily distinguished from *blatchleyi*

by having a submarginal and eight other striae on each elytron.

DIAGNOSIS: A small, ovate, moderately convex *Copelatus* with a distinct submarginal and five other distinct striae on each elytron (Sharp's Group 9). The structure of the male aedeagus is diagnostic (Fig. 1) and indicates the relationship of the species to *debilis* Sharp (Fig. 2). The latter, however, is smaller, more elongate, less convex, less coarsely punctate, and the aedeagus differs in structure. Average length 4.63 mm.; average width at middle of elytra 2.43 mm.

HOLOTYPE MALE: Elongate oval, greatest width at about middle of elytra, moderately convex dorsally. Total length 4.73 mm.; greatest width 2.43 mm. Width at base of pronotum 2.19 mm.; width at apex of pronotum 1.30 mm.; length of pronotum at midline 0.86 mm. Length of prosternal process 0.76 mm.; length from apex of prosternal process to apex of coxal laminae 1.57 mm. Width between eyes 0.78 mm. *Head:* Microreticulate and moderately finely punctate, punctures on vertex separated by from 2 to 3 times their diameter (coarser punctures in usual position for genus). *Pronotum:* Microreticulation and punctation on disk about as on head; coarser punctures along anterior margin, laterally, and in two depressions near the base on either side of middle. *Elytra:* Microreticulation coarser and more irregular than on head and pronotum; punctures along suture and between the impressed striae coarser and denser than on head or pronotum. Each elytron with a submarginal and five other distinct, deeply impressed striae: no sutural stria; first discal stria about twice as distant from the suture as from the second stria; first and second striae a little shorter at base than outer three; second and fifth striae somewhat abbreviated toward the apex (the fifth showing a tendency to turn inward and almost join the fourth toward the apex); submarginal stria originating just before middle of elytra and extending a little beyond termination of the 5th discal stria. *Venter:* Metasternum, coxal plates, and abdominal sternites microreticulate and with some parallel scratches, but not conspicuously punctate in any part. Prosternal process similar to that of

debilis, but relatively stouter and more expanded behind the anterior coxae. *Anterior* and *middle tarsi* moderately dilated; protarsal claws simple. *Anterior tibiae* constricted at base as in *debilis*. *Genitalia*: Parameres similar to those of *debilis*. Aedeagus distinctive (see Fig. 1). *Color*: Head reddish brown, eyes dark. Pronotum dark reddish brown to fuscous on disk, lighter yellowish brown at anterior angles and along margins. Elytra very dark reddish brown to fuscous with a narrow, transverse yellowish brown area at base not quite reaching the suture; margins and apices diffusely lighter. Appendages and undersurface nearly uniformly reddish brown, a little darker along sutures and on abdominal sternites.

ALLOTYPE FEMALE: Similar to male except that specimen is teneral and almost uniformly light yellowish brown above and below. The specimen is in poor condition, but the structural characters are distinct. The anterior and middle tibiae and tarsi are simple. Total length 4.59 mm.; greatest width 2.40 mm. Width of pronotum at base 2.11 mm.; width of pronotum at apex 1.24 mm.; length of pronotum at midline 0.81 mm. Length of prosternal process 0.70 mm.; length from apex of prosternal process to apex of coxal laminae 1.51 mm. Width between eyes 0.78 mm.

VARIATION: The series of specimens before me is relatively uniform. Both of the females are teneral and lighter in color, but do not seem to differ significantly otherwise. The largest male measures 4.75 by 2.54 mm.; smallest female 4.56 by 2.38 mm.

TYPE LOCALITY: Holotype, allotype, two male and one female paratypes, all from FLORIDA: Monroe County, Key West, Mar. 3, 1919, W. S. Blatchley. (These apparently represent all but four of the specimens collected by Blatchley and recorded by him as *debilis*.)

LOCATION OF TYPES: Holotype and allotype in the W. S. Blatchley Collection at Purdue University. One male and one female paratype in the University of Michigan Museum of Zoology, Ann Arbor, Michigan. One male paratype in the Museum of Comparative Zoology (Type No. 29,019), Cambridge, Massachusetts.

THE BIOLOGY OF *BRACHYPANORPA*
(MECOPTERA)¹

BY F. M. CARPENTER
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The Genus *Brachypanorpa*, as now known, consists of only three species, all confined to the United States: one in the southern Appalachian region and two in the north-western region. The distinctive features of the genus are the absence of the long rostrum characteristic of other Mecoptera and the reduction of the wings in the females. The most closely related genus—and indeed the only one which shows any affinities at all with *Brachypanorpa*—is *Panorpodes*, known only from Japan. The species of the latter, however, possess a distinct rostrum and fully developed wings in both sexes.

Virtually nothing has been known of the general biology of either of these two genera. Japanese entomologists have attempted to rear larvae of *Panorpodes*, but without success. During the past two years Dr. F. Y. Cheng and I have made observations on the habits of *Brachypanorpa carolinensis*, both in the field and laboratory, and have been able to work out part of its life-history. The present paper includes our observations on the adults of this insect and brings together some notes on the distribution of all three species of the genus. In another paper Dr. Cheng will give an account of the larva of *carolinensis*.

Brachypanorpa carolinensis (Banks)²

This species was first taken by William Beutenmüller in the Black Mountains, North Carolina, on May 26, 1903, and was described by Banks in 1905 (as *Panorpodes carolinensis*) from seven males in Beutenmüller's collection.

¹ Published with a grant from the Museum of Comparative Zoology at Harvard College.

² For the nomenclature of *Brachypanorpa*, see my revision of the Nearctic Mecoptera (Bull. Mus. Comp. Zool., 72:205-277, 1931).

The exact localities in the Black Mountains at which Beutenmüller found his specimens are not known, but it is clear from a short note published in 1903 that his collecting was done in the southern half of the Black Mountain range. On subsequent trips he took many additional specimens of the species in that range. In late May, 1905, Nathan Banks made a trip to the same region, but most of his collecting was done along the North Fork of the Swannanoa River,³ a few miles north of the town of Black Mountain and just east of Craggy Knob, in the Craggy Mountain range. At this locality Banks collected a great many specimens of *carolinensis*, including the first females. The latter he mentioned in a paper published in 1911, stating that they had very short wings, were unable to fly, and hopped about very lively. Additional females were subsequently taken by Beutenmüller in the Black Mountains.

Other localities for the species were added by R. W. Leiby, who found it abundant near the top of Mt. Mitchell, the highest peak (6700') in the Black Mountains (July, 1919), and who also collected it in the Craggy Mountains (June, 1920) about six miles from the Black Mountains and only three miles from Banks' locality along the North Fork of the Swannanoa. It was also found by F. Sherman at Linville Falls (4000', late May and June, 1920) in the Blue Ridge Mountains, twenty miles northeast of the Black Mountain range.

So far as I am aware, *carolinensis* was not collected again for about thirty years, until May, 1951, when Dr. Cheng, Dr. W. Nutting, Dr. K. Christiansen and I secured many specimens at Carolina Hemlock Camp on the edge of the Black Mountains, and brought back alive 150 males and seven females to Cambridge for study. By what is certainly a striking coincidence, at about this same time (May 17, 1951), several specimens were collected by Dr. P. W. Fattig at Unicoi Gap in Georgia (near the town of Robertson). In May, 1952, Dr. Cheng and I again visited the Black Moun-

³Banks' labels for this locality read, "Black Mt., North Fork Swannanoa". It should be noted that the town of Black Mountain is not in the Black Mountains, but is about twenty miles south of that range.

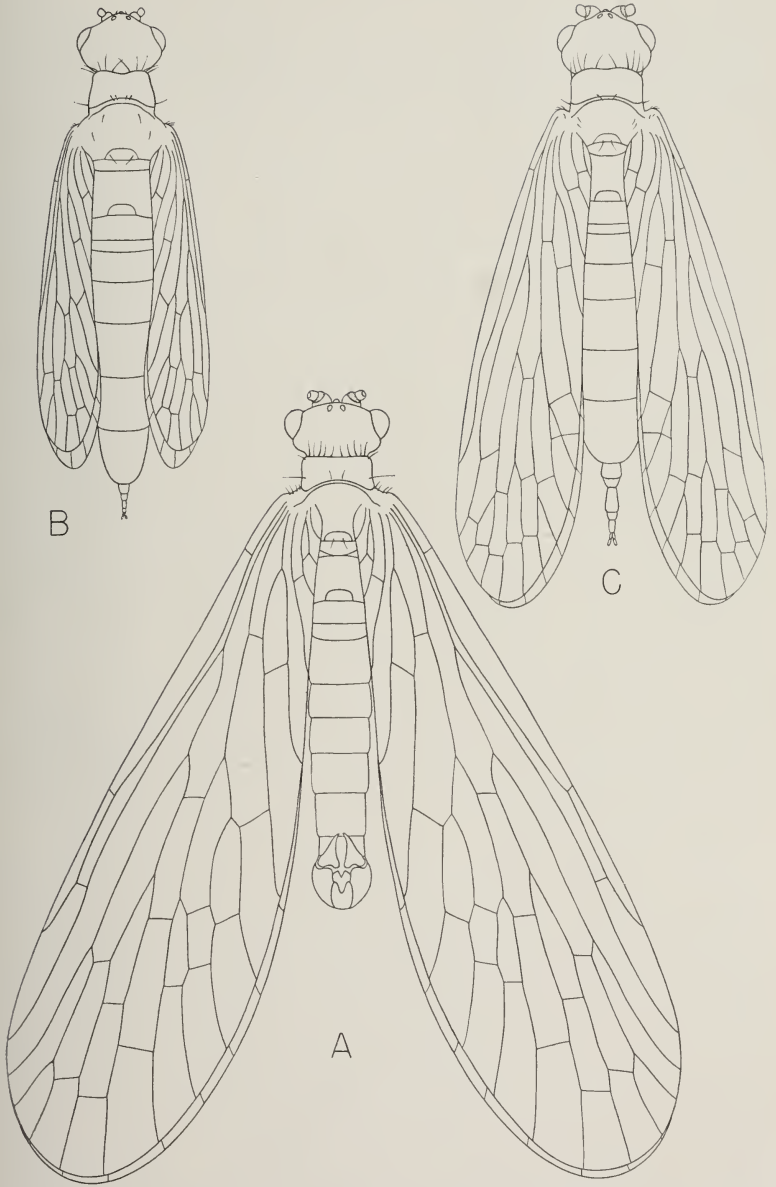
tains. Both sexes of *carolinensis* were active when we reached Carolina Hemlock Camp on May 15. The males remained abundant until June 1, but the females were numerous only on May 20th. Specimens of both sexes were collected at many places in the Black Mountains, including Cobert Creek, towards Deep Gap; along White Oak Creek; along Laurel Fork, near Busick; along South Toe River towards Bald Knob Ridge; at Potato Knob and Stepp Gap (Beutenmüller's localities). Specimens were also found at Craggy Gardens, in the Craggy Mountains. On May 23, 24 and 25, P. W. Fattig and I found many specimens at Unicoi Gap, at Henson Gap, and on Blue Mountain, Georgia (all between 3600' and 4000' elevation).

The history of the collecting of this insect has been given in detail above because it contributes significant evidence to our understanding of a change that seems to have taken place in the female population. As stated above, the females of the three known species of *Brachypanorpa* have smaller wings than the males (see Plate 2). The real notable aspect of the record of *carolinensis* is that all of the females (20 specimens) known to me to have been collected from 1903 to 1920 have wings which do not reach to the end of the abdomen (see Plate 2, fig. B) and which were so small in area that the insects (according to Banks) were flightless and could only hop about; whereas all the females (80 specimens) which Dr. Cheng and I collected in 1951 and 1952 at the previous localities, as well as new ones, have wings which extend beyond the end of the abdomen (see Plate 2, fig. C) and which have such an area that the insects were able to fly distances of several feet.

Since the males taken over the entire period show no differentiation and the females exhibit no differences except in wing size, I believe we are dealing here with a single species, the female population of which has under-

EXPLANATION OF PLATE 2

Brachypanorpa carolinensis (Banks). A. Drawing of male from Carolina Hemlock Camp, North Carolina. B. Drawing of female from Black Mt., N. Fork of Swannanoa, North Carolina (1905). C. Drawing of female from Carolina Hemlock Camp, North Carolina (1951). All drawings are to scale.



CARPENTER — BRACHYPANORPA CAROLINENSIS

gone a marked change in the past thirty years. Although the long winged females may have been present as a small minority in the population before 1920, they are now clearly the majority in the same population. The reverse applies, of course, to the short winged females. It is conceivable that the long winged females, which are able to fly short distances and which might, therefore, more readily find males, have a definite selective advantage over the flightless females. This could account for such a change taking place in the course of a maximum of 30 generations.

The distribution of *carolinensis* presents some interesting features. Its most northern record is now Linville Falls, North Carolina, and its most southern near Unicoi Gap, Georgia. The species seems to be confined to the narrow strip of mountainous country, about 120 miles long, between these two places. However, even in this area, the species appears to be local except for the Black Mountains, where it occurs more generally. With the possible exception of one individual (the data on which are questionable), all specimens of the species so far known to me have been collected at elevations between 3000 and 6700 feet. At the lower elevations, as at Carolina Hemlock Camp (3000'), both male and female adults occur as early as May 15, but virtually all disappear by June 4. At higher elevations (such as 6000'), the adults do not appear until early July; both sexes have been taken as late as July 18 on the top of Mt. Mitchell (6700').

The species occurs only in shady woods, where the soil is moist, though without any definite plant associations. *Galax*, *Rhododendron*, Jack-in-the-Pulpit, jewel weed, asters and May apple occur commonly where *carolinensis* is found, but these plants are characteristic of nearly all moist woods in the southern Appalachian region. Some of them, however, may be necessary as food for the adults of *carolinensis*. Our first efforts to keep the adults alive in cages failed completely because we did not find anything on which they would feed. Bits of animal flesh or of dead insects, which *Panorpa* and *Neopanorpa* readily consume, were not eaten by *carolinensis*. Subsequent observation showed that they fed on the epidermis of soft leaves, such as those of aster

and jewel weed, by scraping the surface of the leaves with their mouth-parts. Caged specimens furnished with fresh leaves lived through the life span of adults in their natural environment.

The males of *carolinensis* fly much like those of *Panorpa*, though usually not quite so far. The females, after pupal ecdysis, crawl up the stems of low-growing plants, and spend much of the time on the ventral surface of the leaves. This undoubtedly explains why so relatively few females have been found. When disturbed, the females will fly, usually downward, to another leaf or to the ground. Mating takes place on the leaves, usually on the upper surface. Complicated courtship, like that in *Panorpa*, is entirely absent; the male quickly approaches and grasps the female with his terminal forceps. Mating usually occurs in the evening, but may take place anytime during the day. A day or two after mating, the female works the tip of her abdomen into the soil and lays a loose mass of white eggs. Details of egg structure and development will be given by Dr. Cheng with his account of the larva.

Brachypanorpa oregonensis (MacLachlan)

This species was first collected on Mt. Hood, Oregon, in 1881, and was described by MacLachlan the same year from males only. The males differ from those of *carolinensis* chiefly by having several long ocellar bristles, absent in the latter. The females, first described by Carpenter (1931), are flightless, the wings being only as long as the thorax (Text fig. 1B).

B. oregonensis has now been found at many localities in the western half of Oregon, in the area extending nearly the full width of the state and about 130 miles inland from the coast. Unlike *carolinensis*, which has been found only at relatively high elevations, *oregonensis* occurs all the way from about sea-level (*e.g.*, Glenada and Walport) to as high as 7000 feet at Crater Lake. Also the seasonal range of the adults is much greater than for *carolinensis*. At relatively low elevations (up to 1000'), the adults have been found from April 20 to June 22; at higher elevations (3000-7000'), from June 19 to August 4. Although there

are no observations on the occurrence of *oregonensis* over a period of several weeks at any one locality, the foregoing records suggest either a longer period of adult life than in *carolinensis* or a greater seasonal period of emergence from the pupae.

A few specimens of this insect have been found outside the state of Oregon. One male (now in the Museum of Comparative Zoology) was collected on the northern Californian coast (Patrick's Point State Park, Humboldt Co., June 2, 1950, W. L. Nutting and F. Werner); another (in the California Academy of Sciences) was taken in northern Idaho, almost at the Canadian border (Coolin, Priest Lake, July 15, 1927, E. C. Van Dyke.⁴ The most surprising record is a male (in the U. S. National Museum) from eastern Utah (Neola, near Vernal, July 13, Harmston). A more extensive series of specimens of *Brachypanorpa* from these northwestern states may show that more than one species is involved in this population, though structural details of both sexes seem notably constant.

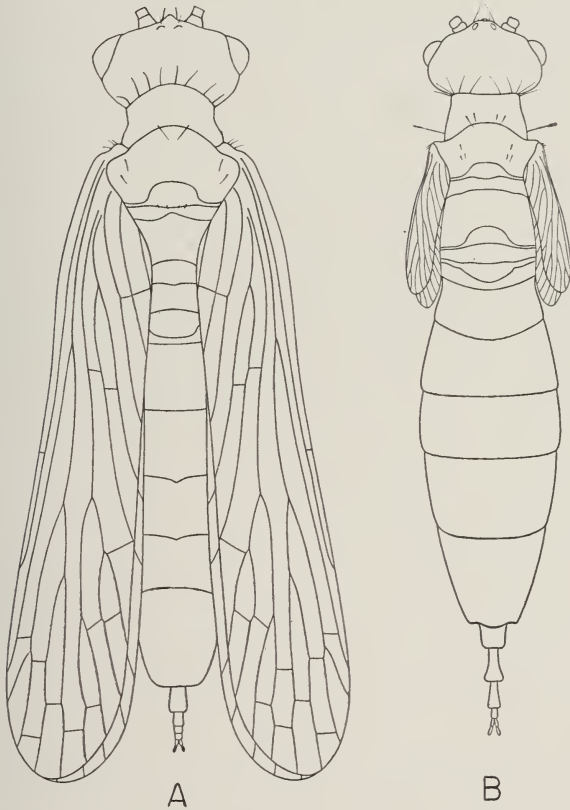
Brachypanorpa montana Carp.

This species was originally based on nine males from Mt. McLoughlin, Klamath Co., Oregon, 8000-9000 feet elevation (July 19, 1930, H. A. Scullen). They were specifically separated from *oregonensis* chiefly on their darker color, since the males of *Brachypanorpa*, like those of *Panorpodes* (Japan), appear to show no marked structural differences between species. Subsequent examination of more specimens of *Brachypanorpa* from Oregon convinced me that the coloration was not a reliable characteristic and that *montana* was a synonym of *oregonensis*.⁵ Since then a female *Brachypanorpa*, having a very dark body and wings which extend beyond the abdomen (Text-fig. 1, A), has been collected at Lake of the Woods, Klamath Falls, Oregon

⁴ I am indebted to Dr. E. S. Ross for the loan of this specimen.

⁵ Records and Notes of Nearctic Mecoptera and Raphidiodea. Bull. Brooklyn Ent. Soc., 34(3):163 (1939).

(5100', July 5, 1946, B. Malkin).⁶ There are several reasons for considering this female a representative of a species distinct from *oregonensis*; and since it was collected near the type locality of *montana*, as pointed out by Miss Parfin, I now believe it advisable to re-instate the latter as



Text-figure 1. A. *Brachypanorpa montana* Carp., drawing of female from Mt. McLoughlin, Oregon. Actual length of specimen, 8.7 mm. B. *Brachypanorpa oregonensis* (McLach.), drawing of female from Mary's Peak, Oregon. Both drawings are to scale.

⁶I am indebted to the U. S. National Museum for the loan of this specimen, which was briefly noted by S. Parfin (Proc. Ent. Soc. Washington, 49:258, 1947).

a valid species and tentatively to assign this female there. Additional collecting, or better still, rearing experiments, will undoubtedly clarify the relationship of this female, of the males described as *montana*, and of *oregonensis*. The most interesting aspect of this female, and my reason for mentioning it here, is its analogy with the long winged females of *carolinensis*, described above. There clearly exist or have existed in both the eastern and western populations of *Brachypanorpa* long winged and short winged females. The collecting data on *carolinensis*, given in some detail above, suggest that the long winged female is now the dominant, if not the only, form in existence in the eastern population. Comparable data on the western females have not been obtained, but I believe the occurrence of even the single long winged female shows that a similar genetical trend, (*i.e.*, towards the development of both short winged and long winged females) has existed in both populations. More intensive collecting of *Brachypanorpa* in Oregon, especially at one locality over a whole season, might furnish data indicating even further similarities.

TWO NEW OREGON CHILOPODS OF THE ORDER GEOPHILIDA

BY RALPH V. CHAMBERLIN
University of Utah

Representatives of the two new centipeds described below were found in a collection belonging to the Oregon State College and submitted to me for study through the courtesy of Vincent D. Roth of that institution.

HIMANTARIIDAE

The genus *Stenophilus* was proposed several years ago by the writer for several species of this family occurring in western America which, while obviously related closely to the European genera *Meinertophilus* and Latzel's *Stigmatogaster* (*Haplophilus* Cook), present some characters which would require substantial emendation of those genera to permit inclusion of the American forms. I am, therefore, retaining for our species the name *Stenophilus*, emended now from the original definition in the light of new species subsequently discovered. *Stenophilus* as far as now known differs from the European genera mentioned in lacking conspicuous sclerotic or chitinous lines on the prosternum and in lacking all paratergites. In *Stenophilus* ventral pores may be absent, present on a few anterior sternites, or on sternites of approximately the anterior half of the body (*rothi* n. sp.). Sternal pouches such as are present in nearly all, if not all, European species of the genera mentioned, have been detected in American forms only in *S. coloradanus* Chamb., in which they occur on segments 25 to 35.

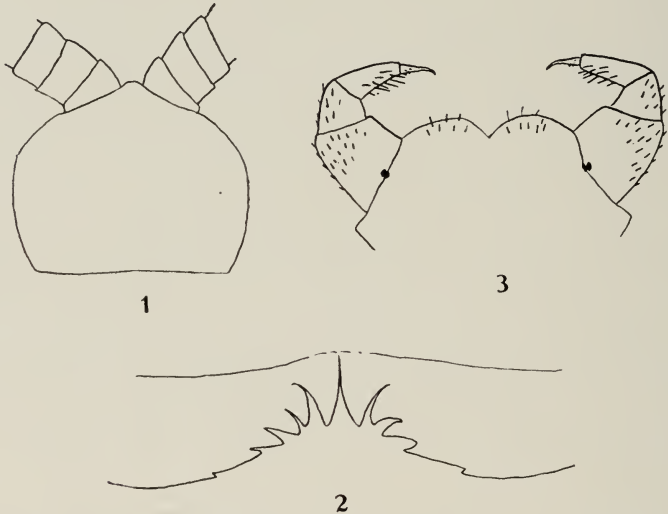
American species referred to *Stenophilus* are now known from Colorado, Idaho, Montana, Oregon and California. They seem to be replaced farther south by species of *Gosiphilus* which are common in Mexico and the border states from California to Louisiana. From these species those of *Stenophilus* are readily distinguished by the deeper, more angular, embayment of the labrum with its much stouter

teeth as well as by the details of the coxopleural region at caudal end.

Stenophilus rothi new species

Body and legs yellow throughout, the head but little darker. Head much wider than long (ad 11.5:9) and of the form shown in fig. 1. Antennae flattened, contiguous at base, the articles proportionately short and broad, the last one subequal to the two preceding taken together.

Median excavation in labrum cutting through to base, the eight median teeth large and strongly sclerotized and laterad from these one or two weaker teeth or serrations on each side as show in fig. 2. Coxosternum of second maxillae with anterior indentation or excision of form shown in fig. 3.



Stenophilus rothi n. sp. Fig. 1. Head in outline. Fig. 2. Labrum, with lateral ends omitted. Fig. 3. Second maxillae.

Dorsal plates plainly bisulcate but the sulci not sharply impressed. Ventral pores in a transverse, narrowly oblong and clearly limited area behind middle of sternites of anterior half of body. Last sternite narrowly trapeziform; prepleurites present on last segment. Coxal pores small

and numerous, present over entire surface. Anal legs inflated in the male, the last article conically tapered. Pairs of legs, 73.

Length of male holotype, 41 mm.

Localities. — Oregon: Marion Co., Silver Creek Falls, male holotype taken by V. Roth on May 12, 1951. Montana: St. Regis, female allotype taken Sept. 23, 1950, also by Roth.

GEOPHILIDAE

Brachygeophilus tampophor new species

Body and legs yellow throughout.

Head a little longer than broad; sides over middle of length gently convex, more strongly rounding in at ends, the caudal margin straight; overlapping the basal plate.

Claws of the prehensors when closed reaching distal end of first antennal article; armed at base with a distinct acute tooth; the other articles and the prosternum unarmed. Prosternum without sclerotic or chitinous lines.

No clypeal areas. Clypeus with three pairs of submedian setae, of which the setae of the anterior pair are farther apart than those of the median, and those of the median pair than the most caudal. Median piece of clypeus bearing typically 7 long conical teeth.

Spiracles all circular. Last ventral plate moderately wide. Coxal pores 5 on each side, the two innermost of which may be partly covered by the ventral plate. Anal pores not detected. Pairs of legs 39 except in one specimen in which there are 47 pairs.

Length, 15 to 20 mm.

Locality. — Oregon: Tombstone Prairie, Santiam Pass. Seven specimens taken Aug. 13, 1949, by V. Roth.

This form differs from other western American species, excepting *B. anonyx*, in having the claw of the prehensors armed at base. From *B. anonyx* it differs in having the anal legs armed with claws as well as in the smaller number of legs.

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TABLE OF CONTENTS

| | |
|---|----|
| Tabanidae from the State of Chiapas, Mexico, with Descriptions of Two New Species (Diptera). <i>G. B. Fairchild</i> | 41 |
| An Australian <i>Trapeziopelta</i> (Hymenoptera: Formicidae). <i>W. L. Brown, Jr.</i> | 51 |
| Australian Carabid Beetles I. Some <i>Clivina</i> from Western Australia. <i>P. J. Darlington, Jr.</i> | 52 |
| Some New Diptera with Remarks on the Affinities of the Genus <i>Pnyxia</i> Joh. <i>F. R. Shaw</i> | 62 |
| The Biology of <i>Euphasiopteryx brevicornis</i> (Townsend) (Diptera, Tachinidae), Parasitic in the Cone-headed Grasshoppers (Orthoptera, Copiphorinae). <i>W. L. Nutting</i> | 69 |
| New Data on the Habits of <i>Camponotus (Myrmaphaenus) ulcerosus</i> Wheeler. <i>Wm. S. Creighton</i> | 82 |

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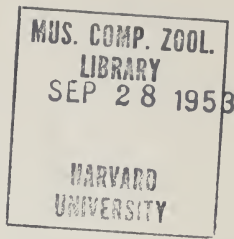
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No. 2

TABANIDAE FROM THE STATE OF CHIAPAS, MEXICO, WITH DESCRIPTIONS OF TWO NEW SPECIES (DIPTERA)

BY G. B. FAIRCHILD

Gorgas Memorial Laboratory, Panama

A survey for Yellow Fever immunity in wild animals, primarily monkeys, undertaken by members of the staff of the Gorgas Memorial Laboratory at the request of the Pan-American Sanitary Bureau furnished an opportunity for the writer to visit several localities in the State of Chiapas, Mexico. Since records of Tabanidae from Chiapas are relatively few, it is believed that a report on the collections made may be of interest. Although all groups of biting insects were collected, only the Tabanidae will be discussed in detail here.

While we were in Chiapas about 5 weeks, from March 20 to April 25, 1951, only 20 days were actually spent in the field, collections being made in the following localities.

TUXTLA GUTIERREZ. This town, the capital of the state, was our headquarters in Chiapas. It lies in a broad valley in a rather dry limestone area. At the time of our visit little rain had fallen for some time, and except along the few streams, the scrubby vegetation was mostly leafless and insects little in evidence. Collecting along the banks of the Rio Sabinal, a small highly polluted stream on the outskirts of the town, yielded a few *Phlebotomus* and great numbers of *Culex* from hollows in large mango and cypress trees. *Simulium* were annoying at times around the hotel, especially during the latter part of our stay, and a few tabanids were taken on the windows of the hotel.

OCOSOCOAUTLA. This is a small town about 50 km. west of Tuxtla on the Pan American highway. Collecting was done on a forested ridge east of the town. The forest consisted mainly of evergreen oaks with fair numbers of *Bursera*, but no palms, much resembling a South Florida oak hammock. Epiphytes were very abundant. A good number of *Phlebotomus* were taken here from shallow buttresses and hollow trees, and a species of *Tabanus* was fairly abundant. Larval ticks fairly swarmed, as cattle had access to the forest. Only one visit of a few hours was made to this locality, on April 8.

PALENQUE. This town is situated in the north eastern corner of the state, not far from the border of Tabasco. The town itself is small and primitive, surrounded by nearly flat sandy country, partly forested and partly open grassland. We took several species of tabanids and *Phlebotomus* in swampy cut-over forest on the outskirts of the town on March 28. From that date to April 4 we were encamped in the Maya ruins which lie about 9 km. from the town on the slopes of a range of low limestone hills. Here we were surrounded by practically virgin forest of Humid Lower Tropical Zone type with abundant palms. Wild animals were quite abundant and monkeys of two genera, *Ateles* and *Allouata* were easily secured. Tabanids were very abundant, and good numbers of *Phlebotomus* and mosquitoes were taken.

SANTA MARIA. This is a hacienda about 51 km. north or north east of Cintalapa by road, about 35 km. airline, situated on the Rio Sta. Maria, a tributary of the Rio Grijalva. At the time of our visit there was a sawmill operating here, owned by the Coabas de Chiapas, S.A. where we made headquarters from April 10 to 19. The sawmill itself is said to be at an elevation of 800 metres and is in a narrow valley at the confluence of two small streams. Immediately adjacent to the sawmill the vegetation is of Arid Lower Tropical Zone type. Across the Rio Sta. Maria, the land rises steeply to a high ridge, the slopes clothed with heavy forest of Humid Lower Tropical Zone type with much mahogany and cedro, which was being cut for the sawmill. We made camp in this forest at a place called La Puerta,

an abandoned lumber camp about 10 km. from the sawmill and said to be at the same elevation, though probably somewhat higher. Here the forest, although considerably cut-over, consisted of very large trees with many palms. It was distinctly dryer than Palenque, though some rain fell during our stay. We were at this camp from April 10 to 13. Collecting at both the camp and the sawmill was excellent.

Much of the collecting was done with the aid of a modified Shannon trap, although the use of a horse as described by Shannon (1939, Amer. J. Trop. Med. 19 (2) : 132-133) was dispensed with. During the day large numbers of Tabanidae and some mosquitoes entered the trap, while at night a gasoline lantern placed in the center compartment attracted nocturnal mosquitoes and some *Phlebotomus*. In the following list those species believed to be hitherto unrecorded for Mexico are starred.

**Assipala melanoptera* (Hine). 19 ♀ Sta. Maria, taken attempting to bite the collector at La Puerta camp. None were taken in the Shannon trap. Previously known only from Guatemala.

Chrysops latifasciata Bell. 3 ♀ Palenque, taken attempting to bite in the forest around the ruins. 3 ♀ Sta. Maria, attempting to bite around La Puerta camp.

Chrysops pachynemia Hine. 1 ♀ Sta. Maria, in forest near sawmill.

Chrysops scalarata Bell. 1 ♀ Palenque, in swampy forest near village.

Chrysops variegata de Geer. 9 ♀ Palenque, in swampy forest near village and wet forest below ruins.

**Chrysops willistoni* Hine. 1 ♀ Palenque, in swampy forest near village. Previously known from Guatemala.

Scione aurulans Wied. 25 ♀ Palenque, very abundant at the ruins, biting man avidly and taken in Shannon trap during the day. 9 ♀ Sta. Maria, abundant at La Puerta camp, but less annoying than at Palenque. More specimens could easily have been taken at both localities.

- Esenbeckia wiedemanni* Bell. 10 ♀ Palenque, attacking man, attempting to bite dead monkeys, and in the Shannon trap at the ruins. 2 ♀ Sta. Maria, in trap at La Puerta camp.
- Esenbeckia illota illota* Will. 1 ♀ Palenque, attempting to bite man in the forest near ruins.
- Diachlorus ferrugatus* Fab. 4 ♀ Palenque, in Shannon trap at ruins.
- Lepiselaga crassipes* Fab. 1 ♀ Palenque, in Shannon trap at ruins.
- Stenotabanus minusculus* Kröb. 2 ♀ Palenque, in Shannon trap at ruins. The tibiae are wholly dark, as described, not lighter as in Panama material, but I can see no other difference.
- **Stenotabanus* n. sp. 9 ♂ 21 ♀ Sta. Maria, attempting to bite and in trap at La Puerta camp. 9 ♀ also taken, mostly in Shannon trap at sawmill. Described below.
- Dichelacera pulchra* Will. 9 ♀ Palenque, in Shannon trap at ruins and attempting to bite in the forest. 1 ♀ Sta. Maria, in trap at La Puerta camp. Smaller and less contrastingly marked than Guatemalan specimens.
- Chlorotabanus mexicanus* Linn. 1 ♂ Palenque, attracted to light near camp in ruins.
- Leucotabanus leucaspis* Wied. 1 ♀ Sta. Maria, in trap at sawmill.
- **Leucotabanus canithorax* Fchld. 1 ♀ Palenque, in trap at ruins.
- Tabanus (Tabanus) subruber* Bell. 2 ♂ 42 ♀ Palenque, very abundant both at village and at ruins, attacking horses in swarms and humans to a lesser extent, entering Shannon trap in very large numbers, where hundreds could have been collected. 7 ♀ Sta. Maria, present in fair numbers both at camp and sawmill, but only a few collected.
- Tabanus (Tabanus) yucatanus* Towns. 6 ♂ 2 ♀ Ocosocautla, males hovering a few feet above trails, females flying around collector and seen biting cattle. 3 ♂ 22 ♀ Sta. Maria, males hovering over small stream, females

in trap. 1 ♂ 1 ♀ Tuxtla Gutierrez, on hotel windows.

Tabanus (Lophotabanus) oculus Walk. 1 ♀ Palenque, in Shannon trap near ruins.

**Tabanus (Lophotabanus) piraticus* Fchld. 5 ♀ Palenque, in forest near ruins in trap and attempting to bite. 12 ♀ Sta. Maria, in trap and attempting to bite in forest around La Puerta camp. This species somewhat crepuscular.

Tabanus (Taeniotabanus) lineola var. *carneus* Bell. 1 ♀ Tuxtla Gutierrez, on hotel window.

Tabanus (Taeniotabanus) amplifrons Kröb. 1 ♀ Tuxtla, on hotel window.

Stenotabanus (Stenotabanus) chiapasensis n. sp.

Fig. 1

Female. Length 7.5-10 mm., of wing 7-8.5 mm. Eyes bare, in life purple to reddish brown with three narrow transverse bands of green or bluish green. The extreme upper margin is greenish purple or narrowly greenish blue. Frons moderately broad, about 3 times as high as wide, light yellowish grey pollinose. Basal callus black, nearly square, as wide as frons, rather protuberant and with two pits or dimples on the upper margin. No median callus in undenuded specimens, though rubbed examples may show a denuded streak on each side and indications of a fine median ridge. Vertex with a rounded flat shiny area, but without swelling, tubercle or vestiges of ocelli. Subcallus, fronto-clypeus and genae yellowish grey, paler than frons, the last two with long pale hairs. Antennae orange yellow, the annulate portion of third segment black. Basal plate longer than annulate portion, moderately wide, evenly rounded above. Palpi yellowish, white pollinose, beset with white hairs basally, black hairs apically, rather slender. Proboscis short, hardly exceeding palpi, the labella large and membranous.

Mesonotum and scutellum dark blackish brown with three yellowish pollinose stripes and the lateral margins of mesonotum and apex and margins of scutellum also

yellowish pollinose, both mesonotum and scutellum beset with sparse shiny yellowish and black hairs. Pleura and sternum steel grey pollinose, thinly white haired. Wings with subepaulet bare, costa, subcosta and first vein setose above, subcosta more densely setose below; a rather long appendix on upper branch of third vein. Wings hyaline, all cross veins and fork of third vein with faint to quite intense dark clouds; apices of 2nd (R_2) and upper branch of 3rd (R_{3+4}) veins with dark clouds and apices of cells R_1 , R_2 and R_4 somewhat dusky. Stigma yellow. Fore coxae yellowish, grey pollinose, pale haired. Fore femora brown, dusky at apex, mostly dark haired. Fore tibiae yellowish and yellow haired on basal half, blackish and black haired apically, as are the tarsi. Mid legs yellowish brown, the tips of tibiae and tarsi a little darker, mostly pale haired. Hind

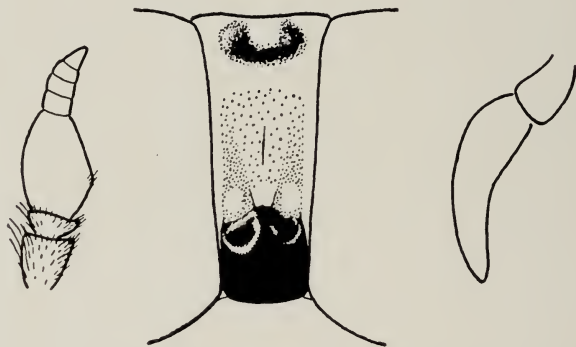


Fig. 1. *Stenotabanus chiapasensis* n. sp. Holotype. Antenna, frons and palpus x 22.

femora brown, grey pollinose, pale haired. Hind tibiae and tarsi yellowish, black haired dorsally, yellow haired beneath.

Abdomen light brown with the following pattern in yellowish and dark brown pollinosity. First tergite mainly dark brown, the anterior angles somewhat bluish, the posterior margin narrowly yellowish. Second to sixth tergites dark brown with a narrow yellowish posterior and lateral

borders, broad median longitudinal yellowish bands which reach both margins but are narrower anteriorly and small round isolated yellowish dorsolateral spots, one on each side. Seventh tergite brown with yellow posterior border. The brown areas and the dorsolateral spots are clothed with black hairs, the remaining yellow areas with yellowish hairs. Beneath the abdomen is thinly grey pollinose, wholly pale haired.

Male. 8-9 mm., of wing 7-8 mm. Head enlarged, eyes bare, holoptic, the area of large facets somewhat over 1/2 total eye area, the two types of facets well differentiated and demarkated. Large facets brown, small facets purple with two narrow green bands and a small segment of a third band at extreme outer angle. Tubercle at vertex deeply sunk between eyes, hardly discernible. Frontal triangle yellowish grey pollinose. Antennae more slender than in female, yellow, the annulate portion black. Palpi inflated, porrect, cylindrical but ending in a sharp point, clothed with long black and white hairs. Wings, legs, thorax and abdomen as in female, except that the abdominal color pattern is less sharply marked, the pollinosity sparser and all hairs longer. The abdomen is also very much more slender, the last few segments narrowed almost to a point.

Holotype, female, Hacienda Sta. Maria, on Rio Sta. Maria, 35 km. north of Cintalapa, Chiapas, Mexico, 15 April 1951.

Allotype male, same locality, 11 April 1951.

Paratypes 28 females, 7 males, same locality, 11, 15 and 18 April 1951, attempting to bite the collectors or in a Shannon trap. All Fairchild and Hartmann colls.

This little species appears to most nearly resemble *St. cribellum* O. S., sharing with it the presence of a bare patch at vertex, but no true tubercle and having a similar frons and callus. In rubbed specimens the trident-shaped median callus shown by Stone (1938) for *cribellum* is quite evident. The male, however, has but a vestige of a vertical tubercle, deeply sunk between the eyes and difficult to detect and the facets are very well differentiated, somewhat in contrast to the male of *cribellum* described by Philip (1941, p. 11). The abdominal pattern and spotted wings will easily

separate the present species from *cribellum*, *pumiloides* Will., *campechianus* Towns. and *subtilis* Bell, all of which appear to be small species with relatively broad frons and a more or less distinct median stripe on abdomen.

This species appears to me to form in some ways a connecting link between such species as *St. littoreus* Hine, and *paitillensis* Fchld. which I would place in *Aegialomyia* Philip, and the more typical species of *Stenotabanus* as represented by the Genotype *taeniotes* Wied. and the closely related *fulvistriatus* Hine. The latter have definite vestiges of ocelli on a small vertical tubercle, and the vertical tubercle of the male of at least *fulvistriatus* is quite obvious and on a level with the eyes. The eye pattern of *chiapasensis* is also closely similar to that of *fulvistriatus*. On the other hand, the relatively broader frons, lack of vertical tubercle and abdominal pattern, seem to indicate relationship to *littoreus*. The pattern of the eye in life seems to be of little help in grouping these species, as *fulvistriatus* has a pattern very much like *jamaicensis* Newst., *ananasi* Fchld. and *psamophilus* O.S., while the eyes of *littoreus* Hine have but two green bands. *Paitillensis* Fchld. is intermediate, having three green stripes, but the middle one very narrow.

I take this opportunity to describe the following new species here, since part of the material is from Chiapas, though it was not taken on our trip.

***Stenotabanus (Stenotabanus) litotes* n. sp.**

Fig. 2

Female. Length 9-11.5 mm., of wing 9-12 mm. Eyes bare, purple with two transverse green bands separated by a purple median band of equal width. Frons yellowish grey pollinose, the basal callus dark brown to black, a little higher than wide, not quite as wide as frons, prolonged above in a spindle-shaped ridge or median callus. Vertical tubercle small but discrete, with vestiges of ocelli and surrounded by a discolored patch which may be more or less bare. Subcallus yellowish pollinose, concolorous with frons, fading to steel grey on genae and frontoclypeus. Beard pale grey. Antennae dull yellowish throughout, the first

two segments sparsely pale pollinose and black haired, the third rather slender with a weak to moderate dorsal angle. Palpi moderately inflated, slender tipped, yellowish, white pollinose, mostly black haired but with more or less white hair basally. Proboscis short, hardly exceeding palpi, brown, the labella fleshy.



Fig. 2. *Stenotabanus litotes* n. sp. Holotype. Antenna, frons and palpus x 22.

Mesonotum light brown, thinly greyish brown pollinose and with two slender, rather faint, yellowish pollinose stripes. Both mesonotum and the concolorous scutellum clothed with pale hairs. Pleura and sternum pale grey, sparsely pale haired. Wings with subepaulet bare, costa, subcosta and first vein setose above, and a short to moderate appendix on upper branch of third vein. Wings faintly yellowish smoky, but without distinct clouds or streaks; costal cell not darker, stigma yellow. Legs dull yellowish brown, the tarsi darker and fore tibiae obscurely bicolored through having pale hairs on basal half, black hairs distally.

Abdomen brown, mainly brown pollinose, but the hind and lateral margins of all tergites pale yellowish pollinose. There are also indistinct pale pollinose narrow median triangles, in most specimens forming a faint to clear median stripe, in a few interrupted on the anterior part of each tergite. In most specimens there are no indications of dor-

solateral spots, but in a few there are obscure and ill-defined paler dorsolateral patches on some or all tergites. Pale yellowish hairs clothe the pale pollinose areas, dark hairs the dark areas. Beneath the abdomen is pale grey, wholly pale haired.

Holotype female, labelled "M.F. 4222 Vigi. Chis. 20-V-35" probably Finca Vergel, Chiapas, Mexico.

Paratypes, 2 females same locality as holotype, labelled 15-V-35 and 21-V-35; 4 females Panajachel, Guatemala, 6 Aug. 1943, and 1 female Tzanjuyu, Panajachel, Guatemala, 20 Aug. 1943, D. M. Jobbins coll.; 3 females Antigua, Guatemala, no date, J. R. de Leon coll.; 4 females Yepocapa, Dept. Chimaltenango, Guatemala, 11 Aug. (1) and 31 Oct. (3), 1949, H. T. Dalmat coll.

The holotype and the two other Chiapas specimens are from the late Dr. A. Dampf's collection, labelled in his handwriting, and sent to me by Dr. C. B. Philip. The holotype and seven paratypes are in Dr. Philip's collection, the remaining paratypes in the author's collection.

This obscurely marked little species was tentatively determined by both Dr. Philip and myself as *St. pallipes* Kröber, described from Brazil. Kröber's description was drawn from a specimen preserved in alcohol, but indicates a much paler, more yellowish insect, and the wings are described as absolutely glass clear. Three of the present series were also alcoholics, but are very much darker than Kröber's description indicates. The present species also shows differences in the frons and a somewhat broader third antennal segment and more slender palpi.

From the description of *Tabanus subtilis* Bell the present species differs in having wholly pale antennae and pale femora. Dr. Bequaert's notes on the types show that *subtilis* is a *Stenotabanus*, with bare subepaulets, and he confirms the presence of a black annulate portion to the third antennal segment.

Tabanus pumiloides Will. differs, according to the description, in having a much more marked angle on the dorsal aspect of the third antennal segment, and also in having a black annulate portion to this segment. The legs are said to be black with the tibiae basally yellow. It seems

difficult to separate *pumiloides* and *subtilis* from the descriptions. Both were described from Mexico, *pumiloides* from Guerrero and Jalisco, *subtilis* from Oaxaca. Direct type comparisons will be needed to achieve certainty in this difficult group, but the present species is separable on color characters at least.

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AN AUSTRALIAN TRAPEZIOPELTA (HYMENOPTERA: FORMICIDAE). — Specimens of *Trapeziopelta* collected by me at Mt. Dandenong (2000 feet) and Olinda (1600 feet) under stones in grassy-floored moist sclerophyll (eucalypt) forest, Dandenong Ranges, Victoria, Australia compare very closely with the types of *Myopias tasmaniensis* Wheeler (1923, Psyche, 30: 177-179, fig. 1, worker), kept in the Museum of Comparative Zoology at Harvard University. My series also compared equally well with types of *Trapeziopelta diadela* Clark (1934, Mem. Nat. Mus., Melbourne; No. 8: 54-55, pl. 4, figs. 7, 8, worker and female). All of the specimens concerned belong to one species, which is correctly assigned to *Trapeziopelta* on the basis of the clypeal structure. The correct name of the species is therefore *Trapeziopelta tasmaniensis* (Wheeler), **new combination**, and *T. diadela* Clark is its **new synonym**. The species is now known from widely separated localities in Tasmania and southern Victoria, where it appears to prefer higher-rainfall sclerophyllous forest.

At least two other species of *Trapeziopelta*, remaining unstudied, occur in southeastern and northeastern Queensland. — W. L. BROWN, JR., Museum of Comparative Zoology, Harvard University.

AUSTRALIAN CARABID BEETLES I.
SOME *CLIVINA* FROM WESTERN AUSTRALIA¹

BY P. J. DARLINGTON JR.

Museum of Comparative Zoology, Harvard University

This is the first of what I hope will be a long series of papers on Australian Carabidae. The papers will be based chiefly on the collection of the Museum of Comparative Zoology. The Museum possesses much material secured in Australia, especially in eastern and southwestern districts, by myself and other members of the Harvard Australian Expedition of 1931-1932; some collected by myself in South Queensland in October and November 1943, while I was staging with the 26th Malaria Survey Unit of the Army of the United States; and sets of duplicates from the South Australian Museum, the National Museum at Melbourne, and from several private collectors; and recently we have received additional interesting specimens from many localities in Australia collected in 1950-1951 by Dr. W. L. Brown, now Assistant Curator of Insects at the M. C. Z. I plan to work up appropriate portions of this material in connection with study of large collections of New Guinean Carabidae secured during the war. The present paper concerns certain interesting Western Australian species of the nearly cosmopolitan genus *Clivina*.

My intention in this series of papers is, so far as possible, to describe only those new species which are well defined and of which we have more than one specimen, and to return at least one of the type series of each new form to Australia. I am particularly anxious that a good set of specimens be deposited at Canberra, with the collection of the late Thomas G. Sloane, who did so much fine work on Australian Carabidae.

The papers of this series are to be regarded as preliminary to more extensive work which I plan to do on Aus-

¹ Published with a grant from the Museum of Comparative Zoology at Harvard College.

tralian Carabidae after (I hope) another collecting trip to Australia and accumulation of much more material. The later work is planned to take the form of revisions with comparative illustrations. Since I cannot foresee the exact forms of illustration which will prove most useful in different groups, I do not plan to illustrate the present preliminary series.

All statements of proportions, *e. g.* the relative widths of head and prothorax, in my descriptions are based upon actual measurements made with a ruled ocular in a binocular microscope. It is not possible to estimate proportions accurately without measuring. Width of head includes the eyes; width of prothorax is greatest width; length of prothorax, length at middle including margins, but not including advanced anterior angles or the peduncle; width of elytra is greatest width; length of elytra, length from a transverse line tangent to the base to apex at suture, with the specimen in normal, flat position.

Sloane's revision of Australian *Clivina* appeared in 1896; his supplementary revision of certain groups, in 1904; and additional descriptions in 1896, 1907, 1916, 1917, and 1923 (see references). These papers lay the groundwork for classification of the Australian species of the genus, but much detailed work remains to be done. There is hardly a species which does not need to be redescribed and figured and its variations studied. Two characters deserve special mention here, one because it has been overstressed by Sloane, the other because it has not been noticed enough. The transverse impression of the declivity of the prosternal process is not a trustworthy taxonomic character; the impression is sometimes both present and absent in different specimens of series of single species from single localities. The inner or flying wings, supposed by Sloane (1896, p. 145) always to be present in Australian *Clivina*, are actually vestigial in some of the species, including one of the new ones described below. Dimorphism of inner wings may occur too, but has not yet been demonstrated in any Australian species of *Clivina*.

The new species of *Clivina* here described have been checked not only against the collection of the Museum of

Comparative Zoology and the literature, but against the collection of the British Museum, which contains Blackburn's types and specimens identified by Sloane. The present new species all go into *Clivina* in the strict sense in Kult's classification (*Acta Soc. Ent. Čechosl.* [Czechoslovakia] XLIV, 1947, 26-37).

Clivina frenchi Sloane (1896, p. 159)

Previously known from North Queensland and from Lake Callabonna, South Australia. I took a series of specimens, which agree exactly with the description, near WILUNA, interior of WESTERN AUSTRALIA, September 28 to October 3, 1931, some on the shores of Lake Violet (near Lake Way) and others beside water holes on Mr. Alfred G. Paterson's station, "Yandil". These specimens vary in size from about 7.0 to 9.5 mm., and in color from dark piceous to rufous with head and prothorax slightly darker. The elytral striae are all free at base in most specimens, but the basal end of the 5th stria is very close to that of the 6th and occasionally the two are connected, leaving only 4 striae free at base. This is an example of the sort of variation, affecting Sloane's group characters, which has not yet been properly studied in most Australian *Clivina*, and which must be understood before the species can be finally arranged in natural groups. *C. frenchi* is apparently closely allied to *C. obsoleta* Sloane (and to the following new species), although Sloane put *frenchi* and *obsoleta* in different groups.

Clivina diluta n. sp.

Parallel, cylindrical, but not more slender than usual; head very large, neck wide; shining, head and prothorax piceous or castaneous, elytra more or less dilute brown; body below piceous or dark rufous, somewhat paler *anteriorly*; anterior legs rufous, antennae and middle and posterior legs brownish testaceous. *Head* $7/8$ or slightly less wide as prothorax (by measurement—to the eye, the head seems virtually as wide as prothorax); mandibles rather short; clypeus with middle part separated from wings, depressed, and rather strongly emarginate at middle, with

angles of median part forming strong teeth; clypeal wings almost as prominent as teeth of median part, with outer angles narrowly rounded, separated from supra-antennal plates by distinct notches; eyes small, only slightly more prominent than supra-antennal plates, but not enclosed behind; 2 supra-orbital setae each side in all specimens; front not distinctly separated from clypeus, only slightly convex, with frontal sulci recurved; occiput without transverse impressed line; middle of front and usually sides and vertex also, but not occiput, closely punctate. *Prothorax* with lateral margins entire or nearly so, but in some specimens becoming vague or obsolete just before reaching basal margin; without longitudinal foveae on episterna; about as long as wide, with sides approximately parallel; front margin distinctly emarginate (as seen on a line perpendicular to pronotum); posterior angles broadly rounded; anterior angles acute except finely blunted (as usual); disc with median line fine, but distinct, anterior transverse impression more or less obsolete, sub-basal lateral impressions long, reaching to slightly in front of middle; surface of disc finely, sparsely punctulate and with a few irregular transverse striae; posterior declivity vaguely rugose. *Elytra* parallel, hardly 1/20 wider than prothorax, truncate at base; 4 inner striae free at base, 5th united with 6th; subhumeral carina short, not very distinct; striae almost entire, but vague or obliterated just before apex, punctulate; intervals nearly flat, 3rd with usual 4 distinct setigerous punctures on outer edge, surface of intervals with some fine, irregular, transverse striae, but not distinctly punctulate. Prosternal process very narrow (attenuate) between anterior parts of coxae; prosternal episterna and lower surface of head and abdomen, especially at sides, with distinct isodiametric microsculpture; body virtually impunctate below. Anterior femora rather strongly lobed below; anterior tibiae each strongly 4-dentate externally, and with upper internal spine somewhat curved and thickened; middle tibiae each with a spur about 1/3 from apex externally. Length about 6.3-7.0; width about 1.7 mm.

Holotype (M. C. Z. Type No. 23,091) and 7 paratypes all from Wiluna and vicinity, Western Australia, most from

Lake Violet but a few from "Yandil", Sept. 28-Oct. 3, 1931; from banks of ponds and water holes.

This new species is closely related probably only to *Clivina obsoleta* Sl. of Cape York (see Sloane's key, 1896, p. 162). The most important difference is probably in the form of the anterior angles of the prothorax. The prothorax is described as slightly narrowed anteriorly in *obsoleta*, with anterior margin truncate and anterior angles obtuse; while in *diluta* the prothorax is parallel, with anterior margin slightly emarginate and anterior angles somewhat acute except that, as usual in this genus, they are slightly blunted. Moreover, the head is probably much more closely punctate in *diluta* than in *obsoleta*, the front of the clypeus is emarginate at middle (described as truncate in *obsoleta*), and the description of *obsoleta* suggests other slight differences. I have not seen specimens of *obsoleta*. I believe that *diluta* is distinct from it, but the former may prove to be only a well-defined western subspecies of it rather than a separate species. The present new species, *diluta*, resembles *C. frenchi* Sl. (as *obsoleta* too is said to do) but is smaller, with a (short) subhumeral carina, relatively longer prothorax, and clypeus much more deeply emarginate at middle. These differences are not sexual, for dissection shows that I have both sexes of both species.

Clivina wiluna n. sp.

Parallel, cylindrical, head not unusually large; brown, darker (sometimes blackish) anteriorly. *Head* about $4/5$ width prothorax; mandibles short; clypeus with middle part separated from wings, angles advanced and dentiform, clypeal wings angulate or sub-angulate externally, nearly as prominent as angles of median part, separated by distinct notches from supra-antennal plates; latter with outer angles somewhat variable in form but usually less (never more) prominent than angles of clypeal wings; eyes prominent, much more so than supra-antennal plates; front not distinctly separated from clypeus, more or less (variably) impressed at middle, frontal sulci recurved, front sparsely or not distinctly punctate, except punctation sometimes more distinct at middle. *Prothorax* slightly ($1/20$ or $1/10$)

longer than wide, slightly but distinctly narrowed anteriorly; anterior margin approximately truncate; posterior angles broadly rounded, anterior ones right or slightly obtuse, blunted; disc with middle line distinct, anterior transverse impression obsolete or nearly so, sub-basal lateral impression short and vague; surface of disc smooth except for a few transverse striae. *Elytra* only 1/10 or 1/20 wider than prothorax, parallel, truncate at base; 4 inner striae free at base, 5th united with 6th; sub-humeral carina short, indistinct; striae entire except some very briefly obsolete at extreme apex, punctulate; intervals slightly convex, 3rd with usual 4 distinct setigerous punctures on outer edge. Prosternal process very narrow (attenuate) between anterior parts of coxae; prosternal episterna dull; body impunctate below. Anterior femora stout, lobed below; anterior tibiae 4-dentate externally, the upper tooth much shorter than the others but distinct and acute; upper internal spine of front tibia somewhat curved and thickened; middle tibia with spur about 1/3 from apex externally. Length 5.7-6.4; width about 1.6 mm.

Holotype (M. C. Z. Type No. 23,092) and 14 paratypes from Wiluna and vicinity, Western Australia, most at "Yandil" but 1 from Lake Violet, Sept. 28-Oct. 3, 1931; from the banks of ponds and water holes.

Apparently closely related only to *Clivina cylindriformis* Sl. from the Gulf of Carpentaria (see Sloane's key, 1896, p. 162). The most important differences are that the front femur of *wiluna* is 4-dentate externally (described as 3-dentate in *cylindriformis*) and that in *wiluna* the clypeal wings are angulate and at least as prominent as and usually more prominent than the angles of the supra-antennal plates (clypeal wings described as rounded and apparently much less prominent than the angles of the supra-antennal plates in *cylindriformis*). As compared with the description of *cylindriformis*, *wiluna* evidently also has the median part of the clypeus with more prominent angles, the front much less punctate, and the color paler; and the prosternum is usually not sulcate across the base in *wiluna*, although this is not a trustworthy character. I have not seen specimens of *cylindriformis*. From *C. obsoleta* Sl., to which

wiluna might be run in Sloane's key, *wiluna* differs in having a much smaller head, with relatively more prominent eyes.

Clivina suturalis Putz.

As Sloane has pointed out (1920, p. 122), *verticalis* Putz. and *dorsalis* Blackb. seem to be synonyms of this species. The species is extremely variable in color. A long series from Rottneest Island (near Perth), Western Australia, taken in October, 1931, varies from elytra testaceous with the sutural region only slightly reddish (these specimens possibly slightly immature) to black with only a short reddish dash behind the humerus, the dash not reaching the middle of the elytral length, and all stages of intermediates occur.

Clivina grata n. sp.

Of about average stoutness for *Clivina*, convex but not cylindrical; color either entirely rufous or rufous with elytra piceous black and lower surface posteriorly rufopiceous; surface above moderately shining. Head $\frac{3}{4}$ or a trifle less width prothorax; mandibles rather short but acute; clypeus with median part evenly slightly emarginate, separated from wings by indistinct, very obtuse notches; eyes small, enclosed behind by convex genae about as long as eyes and nearly as prominent; front not distinctly separated from clypeus, slightly convex between broad facial sulci; vertex slightly impressed at middle; vertex and front, but not clypeus, rather closely punctate. *Prothorax* $\frac{1}{10}$ (slightly \pm) longer than wide, widest about $\frac{1}{3}$ from base, thence slightly narrowed anteriorly; posterior angles broadly rounded, finely denticulate, anterior angles minutely prominent; disc with median line and apical transverse line distinct, surface of disc entirely covered with fine, rather irregular punctation. *Elytra* $\frac{1}{6}$ or $\frac{1}{7}$ wider than prothorax, elongate oval rather than parallel, with humeri slightly narrowed; 3 inner striae free at base, 4th united with external striae; subhumeral carinae distinct; striae entire except partly obliterated at extreme apex, impressed and punctate on disc; discal striae convex, 3rd with 4 distinct setigerous punctures on outer edge. Prosternum

transversely sulcate in front, prosternal process very fine (attenuate) opposite front margins of coxae; prosternal episterna closely rugulose; *indistinct* traces of punctation at sides of prosternum (not on episterna); hind body below roughened at sides but not distinctly punctate. Inner wings reduced to narrow strips about $\frac{1}{2}$ length of elytra; metepisterna shortened. Anterior femur with lower, posterior margin approximately straight (faintly convex) as seen from behind; anterior tibia externally with three long teeth and (above them) a small triangular projection; middle tibia with a slender spur $\frac{1}{3}$ or $\frac{1}{4}$ from apex. Length 5 mm. (or slightly less); width about 1.4 mm.

Holotype (M. C. Z. No. 23,093) and 2 paratypes all from near the town of Margaret River, southwestern division of Western Australia, October, 1931.

This species finds its closest relatives in the *Heterogena* Group of *Clivina*. In Sloane's second key (1904, p. 714) it would go with *olliffi* Sl. and *blackburni* Sl., differing from the former by being smaller and with narrower prothorax, and from the latter by having a distinct anterior transverse line on the pronotum. So far as I can judge from the descriptions alone, there are many other differences too. The separation of the median part of the clypeus from the clypeal wings in *grata* is so slight that the species might easily be referred to the Australasiae Group, where it would run (in Sloane's key, 1904, p. 719) to *ferruginea* or to *nigra* or *occulta*, but it probably is not really very closely related to any of these.

In my opinion, this new species (*grata*) really represents some stock close to *heterogena* Putz., modified as a result of reduction of the wings. The other characters which distinguish *grata*, especially the more oval elytra and shortened metepisterna, often accompany or follow wing-reduction among Carabidae (*cf.* Darlington 1936) and occur in some other (unrelated) flightless Australian *Clivina*, especially in the Procera Group. Even the reduced eyes of *grata* may be a secondary result of wing atrophy. I took, also at Margaret River, a single specimen of a *Clivina* which *may* represent the winged stock from which *grata* has been derived. It is bicolored like some examples

of *grata* and is similar also in many ways structurally, but it is fully winged, with elytra parallel-sided, metepisterna long, and eyes relatively large. In these respects it is very close to *heterogena*, of which we have a series from Victoria. However, the Margaret River specimen differs from both *heterogena* and the present new species (*grata*) in having the abdomen rugose-punctate, most strongly so on the apical segment. The differences between this specimen and *grata* seem too great for them to be forms of a single dimorphic species. This specimen very likely represents a new species, but I do not care to describe it without more material.

Clivina sculpticeps n. sp.

Rather broad, subparallel, only moderately convex; rufous, not very shining. *Head* about 7/10 width prothorax; mandibles short; clypeus with marginal outline as in *australasiae* and its immediate allies, broadly emarginate at middle, with median part not at all separated from wings; latter rounded, separated from supra-ocular plates by obtuse notches; eyes prominent; front separated from clypeus by a deep and conspicuous transverse impression, and clypeus before impression with a broad more or less semicircular swelling; front and usually vertex somewhat variably longitudinally impressed at middle, and usually also with oblique irregular impressions at sides; frontal sulci long, recurved; front impunctate or virtually so; occiput with a few punctures at sides. *Prothorax* as wide as long or barely wider, moderately narrowed anteriorly; posterior angles broadly rounded, slightly dentate; anterior angles also rounded, but more narrowly so; disc with median and anterior transverse lines distinct, sub-basal lateral impressions faint or obsolete; surface of disc impunctate, with a few transverse striae. *Elytra* about 1/10 wider than prothorax, only slightly narrowed anteriorly, with base subtruncate; humeri distinct, rather narrowly rounded; only 3 striae free at base; sub-humeral carinae well developed; striae entire, moderately impressed (less so apically), punctulate; intervals convex, 3rd 4-punctate as usual. Prosternum more or less sulcate transversely anteriorly, with episterna striolate and rugulose, not punctate;

prosternal process narrow but not "attenuate" between anterior parts of coxae; body below locally rugulose but not punctate. Anterior femora with lower posterior margin slightly convex; anterior tibiae strongly 3-dentate; middle tibia with a strong spur about $\frac{1}{4}$ from apex externally. Length 7.8-9.0; width 2.2-2.5 mm.

Holotype (M. C. Z. Type No. 23,094) and 4 paratypes all from Geraldton, Western Australia, October, 1931. Also 1 specimen, not a type, measuring only 6.5 by 1.8 mm., from Meekatharra, Western Australia (nearly 300 miles inland from Geraldton), Sept. 25, 1931.

The form of the clypeal margin and the distinct joining of the 4th and 5th elytral striae at base put this new species in Sloane's Australasiae Group. In Sloane's second key (1904, p. 719) it actually runs to *australasiae* and the latter's close relatives *lepida* Putz. and *dingo* Sl., but the new species (*sculpticeps*) differs from all of them by the conspicuous and rather complex sculpture of the head. The brown rather than black coloration is probably also a distinguishing character of *sculpticeps*, but a relatively unimportant one.

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SOME NEW DIPTERA WITH REMARKS ON
THE AFFINITIES OF THE GENUS *PNYXIA* JOH.

BY F. R. SHAW

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In a lot of material sent to me for identification by Dr. Peter Bellinger, while a student at Yale University, I found some specimens of unusual interest. Most of the insects fall in the genus *Bradysia** of the family Sciaridae. There were a few Mycetophilidae.

By far the most interesting insects were small Diptera resembling Cecidomyiidae. The females are wingless and lack halteres. The males have antennae similar to certain gall midges. At first, the specimens were believed to fall in the genus *Peyerimhoffia* but further study indicated that their affinities were not with this group. It was finally determined that the insects would fall within the genera *Pnyxia* Johannsen or *Epidapus* Haliday.

Through the kindness of Alan Stone of the U.S. National Museum, I was able to borrow specimens originally described by Hopkins as *Epidapus scabiei* but subsequently placed in the genus *Pnyxia* by Johannsen. Two characters used to recognize *Pnyxia* include the absence of the dorsal eye-bridge and the shape of the palpi. Since the dorsal eye-bridge is greatly reduced in the females I was examining, I wondered if Hopkins could have overlooked this structure. My material also possesses a one-segmented maxillary palpus as is characteristic of *Pnyxia*.

A thorough study of *Pnyxia scabiei* (Hopkins) revealed the complete absence of an eye-bridge. The palpi although one-segmented are more or less cup-shaped and possess a great number of small peg-like setae on the concave surface. These are entirely lacking in the specimens I was examining. Another feature I found of value to distinguish my material

* I am following the interpretation of Frey, 1948, of the generic concepts of the Sciaridae.

from *Pnyxia* is that in *Pnyxia* there is a snout-like projection above the antennae.

In general appearance, the males of my specimens closely resemble those of *Pnyxia* except for the palpal structure and presence of an eye-bridge. The eye-bridge in both sexes is greatly reduced being not over one facet wide in the male and possessing a total of eight facets in the female. In the female most of the facets are located in front of the ocelli and they are easily overlooked.

The systematic position of *Pnyxia* has been somewhat uncertain. Johannsen, 1912, indicated that according to Enderlein, this genus would be placed in the Mycetophilinae. Edwards, 1925, placed the genus in the Sciophilinae. Frey, 1942, makes the following statement concerning this genus, "nicht zu den Sciariden gehören die Gattungen *Pnyxia* Joh. und *Allostooma* Schmitz." My conclusions concerning this matter are that *Pnyxia* is a sciarid. The thoracic sclerites show that the affinities of the genus are closest to the Sciaridae. The reduced eye-bridge in the specimens I am naming as a new species of *Epidapus* is certainly a step toward the loss of the eye-bridge in *Pnyxia*.

A total of four new species was found in the course of study of the specimens. These include *Epidapus johannseni*, *Zelmira williamsi*, *Bradysia bellingeri* and *B. farri*. Their descriptions appear herewith.

***Epidapus johannseni* n. sp.**

Male. Length 1 mm., General color dark brown, legs and abdomen lighter. Resembles a cecidomyiid in general appearance.

Head. Antennae about 1.5 the length of the body. The basal two segments compact, the second bulb-like. The flagellar segments, with the exception of the terminal one, attenuated at the tip, see figure 1. Antennal hairs more or less verticillate. The intermediate antennal segments are about 0.16 as broad as long. The attenuated portion of each of the segments is about 0.33 the length of the entire segment. Compound eyes sparsely hairy. Eye-bridge present, narrow, for the most part possessing a single row of facets.

Ocelli 3, prominent. Maxillary palpi one-segmented, somewhat paler than rest of mouthparts.

Thorax dark brown. Wing slightly more than 1 mm. long, slender, anal angle greatly reduced. Anterior wing veins most evident. Costa extends about 0.5 the distance from R_s to M_{1+2} . Humeral crossvein present. Only the radius with macrosetae. R_{1+2} ends at about 0.375 of length of wing. R_s ends before tip of M_3 at about 0.78 the length of the wing. Petiole of M indistinct. Petiole of Cu is practically absent. In some specimens the anterior branch of Cu appears to originate from the petiole of M . Halteres pale brown, about 0.25 the length of the wing. Legs dark brown. Tibial spurs present, paired on meso- and metathoracic legs. Anterior tibia about 0.81 the length of the tarsus. The basitarsus is about 0.40 the length of the tibia. Tarsal claws simple. Pulvilli and empodium with prominent hairs.

Abdomen. Brown in color, somewhat paler at tip. Clasper, figure 2, about 0.66 as broad as long has about 6 spines on the mesal, apical surface of which the dorsal one is most conspicuous. Frey's key, 1948, would place this species near *E. abieticola* Frey described from *N. Esbo*. It differs in the details of the structure of the hypopygium.

Described from 7 males from Mt. Higby Reservoir, Hartford County, Connecticut, March—July 1951.

Female. Length 1.5-2 mm. General color brown.

Head. Dark brown. Antennae 16-segmented, segments not attenuated at tip as in males. Antennal hairs somewhat verticillate. Antenna about 0.28 the length of the body. Compound eyes sparsely hairy. The number of facets is reduced. Dorsal bridge present but the number of facets not over 8 mainly located in area of bridge anterior to ocelli. Ocelli 3, prominent. Mouthparts small, maxillary palpi one-segmented with two prominent setae.

Thorax. Wings and halteres absent. Legs pale brown.

EXPLANATION OF PLATE 3

Fig. 1. Fifth flagellar segment of male *Epidapus johannseni*. Fig. 2. Dorsal view of male hypopygium of *Epidapus johannseni*. Fig. 3. Ventral view of male hypopygium of *Zelmira williamsi*. Fig. 4. Ventral view of male hypopygium of *Bradysia bellingeri*. Fig. 5. Ventral view of male hypopygium of *Bradysia farri*.

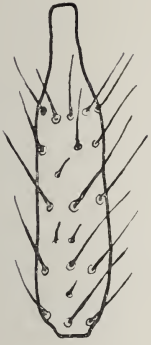


FIG. 1

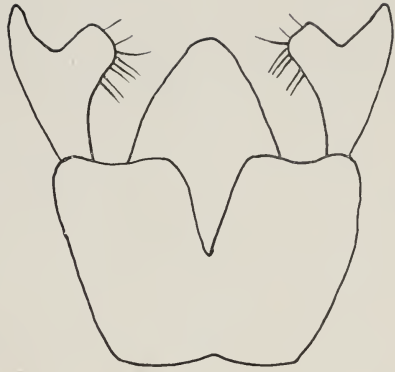


FIG. 3

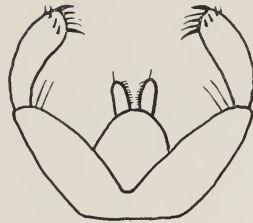


FIG. 4



FIG. 2



FIG. 5

Coxae elongate, not especially robust as in *Pnyxia scabiei*. Tibial spurs present. Prothoracic tibia slightly shorter than tarsus. Basitarsus about 0.33 length of the tibia.

Abdomen pale brown. Ovipositor prominent.

Described from 35 specimens from Mt. Higby Reservoir, Hartford County; Middlefield; and Cathedral Pines, Litchfield County, Connecticut, January—August 1951. Male and female holotypes and 2 paratypes in my collection, the remainder in collection at Yale University.

I take pleasure in naming this species for Dr. O. A. Johannsen, an outstanding American dipterist.

Zelmira williamsi n. sp.

Male. Length 6 mm. General color brown.

Head. Dark brown. Antennae short, about subequal to length of the thorax. Ocelli 3. prominent. Maxillary palpi 3-segmented, first segment darker than the other segments.

Thorax. Dark brown. Postnotum with bristles. Pleurites are bare. Wings yellowish with a terminal dark band. Costa terminates at tip of R_{4+5} . Sc_1 ends before origin of R_s . Sc_2 present, about 1/2 way between humeral crossvein and tip of Sc_1 . R_3 almost perpendicular to R_{4+5} , ends about 0.33 the distance from tip of R_{1+2} to tip of R_{4+5} . A brown band covers the terminal sixth of the wing. Fused portion of M subequal to the petiole of M . Two distinct anal veins. Legs yellow. The tarsi appear darker due to the presence of numerous black setulae. Prothoracic basitarsus about 0.9 the length of the tibia. Tibial spurs brown. Some of setae on meso- and metathoracic tibiae are arranged in lines. Halteres brown, the knobs a little darker.

Abdomen dark brown. Apices of segments 2-4 with yellow bands. Remainder of segments including the hypopygium dark brown. Clasper, figure 3, of the "genualis" type but lacks the long mesal spur. In Fisher's manuscript key this species would run to *Zelmira genualis* Joh. It can be distinguished from this species by the shape of the claspers and the shape of the tergum.

Described from 1 male collected in a soil sample from a virgin White Pine and Hemlock stand in Cathedral Pines,

Litchfield County, Connecticut on May 16, 1951. Type in my collection.

I take pleasure in naming this insect for my son, William Morse Shaw.

***Bradysia farri* n. sp.**

Male. Length 3 mm. General color dark brown.

Head dark brown. Antennae 16-segmented somewhat paler in color. Mouthparts yellowish brown. Maxillary palpi 3-segmented.

Thorax. Dark brown. Wings 2.75 mm. long. Costa strong, extends about 0.75 distance from tip of R_{4+5} to M_{1+2} . R_{1+2} ends at about 0.56 distance from wing base to its tip about opposite fork of M. Rs originates proximad of mid-point between humeral crossvein and tip of R_{1+2} . Both branches of radius have setae. M_3 ends only slightly beyond tip of R_{1+2} . Petiole of cubitus about 0.88 as long as basal portion of media Halteres pale brown. Legs—Coxae yellowish brown, remainder of legs yellowish. Ratio of prothoracic basitarsus to its tibia 0.60. Tibial spurs yellowish with dark setulae.

Abdomen dark brown. Hypopygium, figure 5, resembles somewhat that of *B. acuta* Joh. Clasper with a strong terminal spine and about 8 setae on its inner surface.

In Pettey's key, 1918, this species would run to *Bradysia varians* Joh. It differs from this species in venation, in the structure of the clasper, and in other details. Described from 1 male collected at Mt. Higby Reservoir, Hartford County, Connecticut on March 7, 1951. Type in my collection.

I take pleasure in naming this insect for Thomas Farr, an outstanding student in entomology who has a firm belief in the value of the study of insects in their natural habitats.

***Bradysia bellingeri* n. sp.**

Male. Length 2.25 mm. General color dark brown.

Head dark brown. Antennae and mouthparts paler. Maxillary palpi 3-segmented, yellowish brown.

Thorax dark brown. Wing 2.0 mm. long. Costa extends

about 0.75 the distance from tip of R_{4+5} to M_{1+2} . R_{1+2} ends proximad of fork M at about 0.5 the length of the wing. Rs originates about 0.70 the distance from the humeral crossvein to the tip of R_{1+2} . Only the radius has setae. M_3 ends opposite tip of R_{4+5} . Petiole of cubitus about 0.60 as long as basal portion of media. Halteres pale brown, tips darker. Legs yellow, appearing darker toward apices due to presence of fine black setulae. Prothoracic basitarsus about 0.62 as long as the tibia. Tibial spurs yellow.

Abdomen dark brown, terminal portion somewhat paler. Hypopygium, figure 4, resembles *Bradysia diluta* Joh. somewhat.

In Pettey's key, 1918, this species would run to *Bradysia scita* Joh. It can be distinguished from *B. scita* by the structure of the clasper of the hypopygium which lacks a mesal lobe as shown for *scita*. In addition *B. bellingeri* possesses a strong apical spine and 3 sub-apical spines on the mesal surface. Described from 1 male collected in a soil sample from a stand of Red Pine at Mt. Higby Reservoir, Hartford County, Connecticut on March 27, 1951. Type in my collection.

I take pleasure in naming this species for Dr. Peter Bellinger who sent me these specimens for determination.

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THE BIOLOGY OF *EUPHASIOPTERYX BREVICORNIS*
(TOWNSEND) (DIPTERA, TACHINIDAE),
PARASITIC IN THE CONE-HEADED GRASSHOPPERS
(ORTHOPTERA, COPIPHORINAE)*

BY W. L. NUTTING

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The presence of oddly placed, supernumerary "spiracles" on a number of cone-headed grasshoppers [*Neoconocephalus r. robustus* (Scudder)] collected on Cape Cod in August, 1951, suggested parasitism by dipterous larvae, probably of some tachinid fly. Collection and confinement of a number of parasitized individuals during late summer in 1952 and '53 eventually led to the successful rearing of three male and two female flies. After considerable study, which involved not only these specimens but a large part of the accessible material in the difficult tribe Ormiini, C. W. Sabrosky of the Bureau of Entomology and Plant Quarantine is now describing the fly as a new subspecies of *Euphasiopteryx brevicornis*. (Sabrosky, in press). Reinhard in 1922 published a record of three larvae which emerged from an adult cricket, *Gryllus assimilis*, and formed puparia. Although no flies emerged, C. T. Greene identified the puparia as *Ormia* (now *Euphasiopteryx*) *ochracea* (Bigot). There is but one record of undoubted host relationship for the genus, that of "*E. australis* (Tns.)" as a parasite of the Brazilian mole cricket, *Scapteriscus vicinus* Scudder, reported by Wolcott (1940).¹ The cryptic habits of both host and parasite emphasized in the present paper further explain the scarcity and incompleteness of the previous life history data on these flies.

The locality where the parasitized cone-heads were

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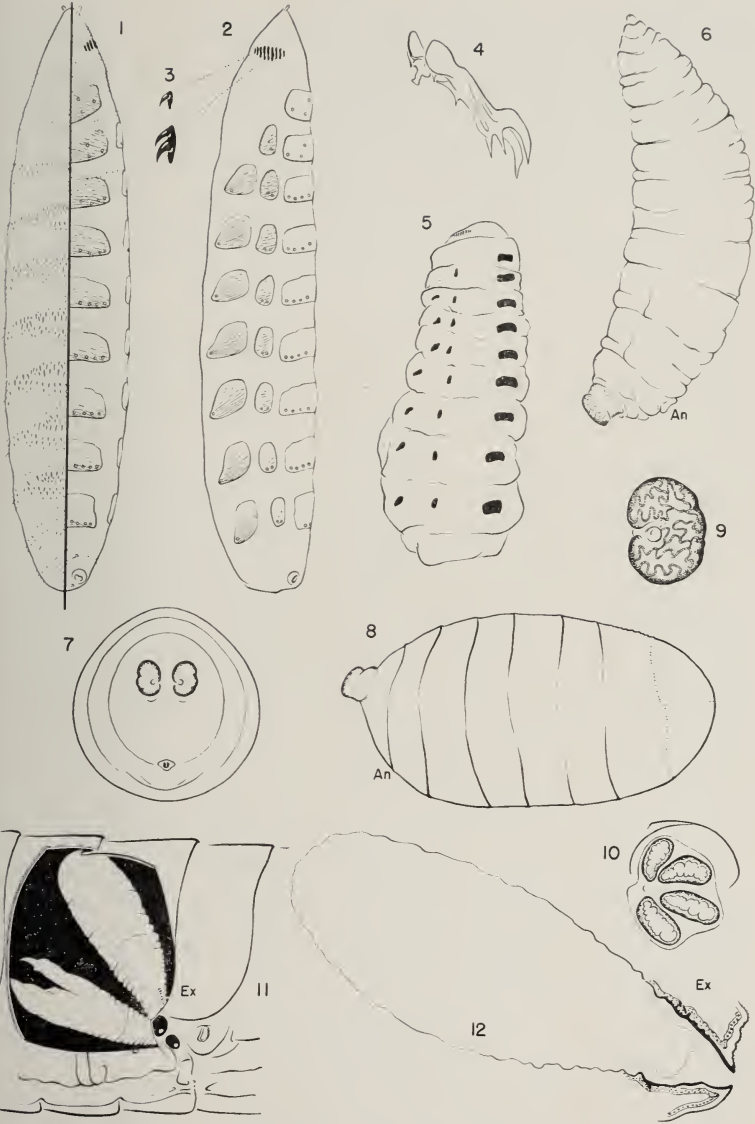
¹ *Australis* sensu Wolcott = *E. depleta* (Wiedemann), teste Sabrosky, 1953; *E. australis* (Tns.) from Peru is distinct. Hereafter, *E. australis* sensu Wolcott will be used in quotation marks.

collected is a narrow 16 acre tract, extending from the beachgrass-lined bay inland 0.4 mile to U.S. Route 6 in East Brewster, Mass. One fourth of the land bordering the beach is characterized by *Hudsonia*-lined sand-blows dotted with red pine, while the adjoining fourth is overgrown swamp. The remaining eight acres are largely open fields, supporting an occasional red cedar and bordered with clumps of bayberry and beach-plum. The cone-heads were confined to the beachgrass and open fields, although one or two specimens were taken in the bayberry bushes. Because of their alertness and habit of dropping from the tops of grasses and shrubs into inaccessible tangles below, the most practical collecting method is that of night-stalking. In early evening the ear-splitting, cicada-like song of a male is pin-pointed, then approached upwind; with careful maneuvering the singing insect may be spotted and grabbed or tricked into a ready net. Thus the taking of females is limited to chance sightings or association with singing males.

In this manner eight males were collected in the eight acre tract between 15 and 17 August, 1951; six were parasitized. On 3 August, 1952, seven males were parasitized of ten collected in the same area; three unparasitized males came from the beachgrass section. From the number of individual songs noted, probably at least 75 per cent of the male population in the tract were taken each season. The incidence of parasitism in this area, of the males at least, is certainly much higher than the one to five per cent

EXPLANATION OF PLATE 4

Euphasiopteryx brevicornis (Tns.). Fig. 1, left half, ventral aspect of 0.8 mm first instar larva; right half, dorsal aspect. Fig. 2, left lateral view of same, spines omitted. Fig. 3, detail of larval hooks. Fig. 4, first instar cephalopharyngeal skeleton. Fig. 5, 1.3 mm first instar larva after feeding. Fig. 6, nearly mature, 10 mm larva, An, anus. Fig. 7, posterior view of 8 mm puparium. Fig. 8, right lateral view of same. Fig. 9, detail of mature larval spiracular plate (x44). Fig. 10, detail of second instar spiracular plate (x457). Fig. 11, abdominal cutaway of the host, *Neoconocephalus r. robustus*, showing larval respiratory funnels in place; lower funnel was ruptured by escaping larva (x13). Fig. 12, longitudinal section of funnel showing larval posterior in place (dotted); Ex, first instar exuviae embedded in funnel wall (x40).



NUTTING — EUPHASIOPTERYX

reported by Wolcott (1951). A total of 50 larvae and vacated larval respiratory funnels was found in these 13 grasshoppers, an average of 3.85 per host. Two hosts contained one larva each, while two others contained eight and nine. Since all hosts were collected within three days in 1951 and on a single date in '52, the size range and probable age of the larvae are particularly noteworthy. In all specimens containing more than two larvae, considerable variation in larval size was found. This probably indicates different larval entry times, although it is also suggestive of feeding competition among the larvae. Two hosts which each contained one first instar larva, also contained six and seven other larvae of various sizes, including several three quarters grown. Another contained a first instar larva along with two more which were ready to pupate.

The dissection of three species of adult female ormiines by Townsend (1911) indicates that larviposition may be the rule with these flies. It is not known whether the females deposit their larvae directly on the host insects, or merely on ground or vegetation frequented by them. The armored, planidium type first instar larva (figs. 1 and 2), coupled with the following observations, suggests an active seeking out of host by larva. Four of the cone-heads collected contained first instar larvae, one of which was found in the muscles of the right hind femur, one quarter of the femur length from the coxa. This cone-head had been killed and pinned, so that even though the larva was found headed apically in the femur, there is no assurance that this was the case before death. Although it is tempting to speculate that it had entered the host through soft or membranous areas of the tarsus, it might be argued that it had entered at any other point and become diverted into the leg in making its way to the abdomen.

On the other hand, a careful autopsy of seven cone-heads showed that not one of 30 larvae was encountered in any part of the body but the abdominal cavity. Twenty more larvae, or larval funnels, in the six other cone-heads were also restricted to the abdomen. The second first instar larva was found near the anterior end of the mid gut, and the third in a tangle of malpighian tubules, both free in the

haemocoel. The fourth larva (fig. 5) had recently become fixed to the pleural membrane on the left side of the fifth abdominal segment. This evidence suggests that the larvae are strongly attracted to the host's abdominal haemocoel, and that they probably do not often miss this goal. It is possible that entry may occasionally be effected via vulnerable areas of the appendages in contact with the ground. In any case, the paired sets of hooks on the second segment (fig. 3) undoubtedly assist the larvae during penetration of the host.

There was no apparent evidence of larval entrance on any of the 13 parasitized cone-heads, although it might be mentioned that five bore from one to four 0.5 to 1.5 mm scars on either or both faces of their hind femora. No such scars were found on the uninfected specimens. They may be significant, but it would be difficult to understand how or why the larvae would enter at such a point. It is more likely that these scars were earned during battle with other males, or perhaps during or after mating.

Although not exactly popular knowledge, the unusual respiratory funnels used by tachinid larvae for obtaining an atmospheric oxygen supply have long been known from the early biological researches of Nielsen (1909) and Pantel (1910). Baer (1920), Thompson (1928), and Beard (1942), have also contributed to our understanding of larval respiration and host relationships within this group of flies. (See Clausen (1940) for a comprehensive review.) York and Prescott (1952) have reported that similar funnels are also formed by nemestrinid larvae in grasshopper hosts. *Euphasiopteryx* behaves typically for, after the active larva enters the cone-head's abdomen, it perforates the host's body wall and settles down with its posterior spiracles in contact with the outside air until it is nearly ready to pupate. Perforation of the host integument may be accomplished by means of the minute circumstigmatal spines as suggested by Beard, or in the case of larvae such as these, perhaps by means of the postcephalic recurved hooks. In any event, the larva, with its spiracles in this hole, obstructs the normal healing of the wound in such a manner as to cause an inward growth of host integument which eventually

forms a funnel around its posterior end (see Beard, 1942).

With *Euphasiopteryx*, the funnel walls are extended by a brownish, transparent, acellular membrane, so that the larva is completely enclosed in a sac-like structure (figs. 11 and 12). This type of funnel has been described for certain other tachinids, and Nielsen (1909) claims that the saccular portion is composed of the compacted walls of host fat body cells destroyed by the larva. Pantel (1910) presumed that the enclosed larva fed on the host's body fluids absorbed through the sac walls. However this may be, he stated that at a later stage such larvae pierce the sheath and feed actively on fat body and other tissues. This may be the case with *Euphasiopteryx*, for most over 6 or 8 mm long had ruptured their sheaths (fig. 11).

In the cone-heads examined, all the darkened external funnel openings were situated either in the soft pleural integument or in the ventral intersegmental membranes, from the first through the eighth abdominal segments (fig. 11). Internally the basal 1 or 2 mm of the funnel bear heavily sclerotized annular thickenings (fig. 12), while the whole structure is often enveloped in the lobular fat body, covered with blood cells and detritus, and wound round with malpighian tubules. The first instar exuviae (figs. 11 and 12, Ex) are embedded in the thickened layers of cuticle at the funnel base, but no trace of later molts has been found. Cast larval skins of the squash bug parasite, *Trichopoda pennipes* Fabr., have been found either embedded in the sheath or, more commonly, between the maggot and its sheath (Beard, 1942).

Although the remarkable first instar larvae of *Phasiopteryx montana* Tns. [*E. ochracea* (Bigot)] and *P. bilimeki* BB. [*E. bilimekii* (BB.)] were described and figured by Townsend (1912, 1942), drawings of this stage of *brevicornis* are included here for comparison. This active, armored larva (figs. 1 and 2), shortly after entering the host, measures about 0.8 x 0.15 mm. It has already done sufficient feeding so that the nine dorsal plates and the flanking rows of eight dorsolateral and seven ventrolateral plates no longer overlap as shown by Townsend. The light brown plates are sculptured, and bear a pattern of round,

unpigmented spots. These hole-like dots form triangular patterns on the first two dorsal plates as described for *E. ochracea* by Townsend. In the present well preserved material, the spots do not appear to be origins of detached bristles as he suggested. Ventrally the abdomen is equipped with six compact groups of long spines instead of plates, while posteriorly and anteriorly the body is ringed with bands of microspines. The last segment, adorned with a few larger spines, bears the slightly raised spiracular plates which are bounded anterolaterally by a lightly pigmented area. Anteriorly there is a group of claw-like spurs on either side of the second segment, similar to those described for *E. bilimekii*. Each group is made up of nine heavily sclerotized rods, the seven median ones each bearing two hooks, and the end rods, one each (fig. 3). The cephalopharyngeal skeleton (fig. 4) extends back to the anterior margin of the first dorsal plate. The antennae are rather prominent elongate papillae. After considerable feeding, and at the time it becomes sedentary, this larva measures about 1.3 x 0.8 mm, and appears as shown in fig. 5.

Mature larvae, ready to pupate (fig. 6), are typical white maggots and measure from 9 x 3 to 13 x 4.5 mm. They are practically smooth, although segmental bands of minute spines become barely visible at 90x in sectioned material. The pair of large, well separated posterior tubercles which bear the spiracles are shining black. The reniform spiracular plate (fig. 9) bears an inconstant serpentine pattern of minute parallel ridges. Between these ridges is a single row of breathing pores leading to the atrium within the tubercle. The stigmatic scar, representing the spiracle of the previous instar, is eccentrically placed opposite the hilum on the plate's inner margin. Figure 10 is a detail of the typically muscoid spiracular plate of the second instar larva. Prominent fleshy lobes mark the anal opening (An) which is rather remote from the spiracles.

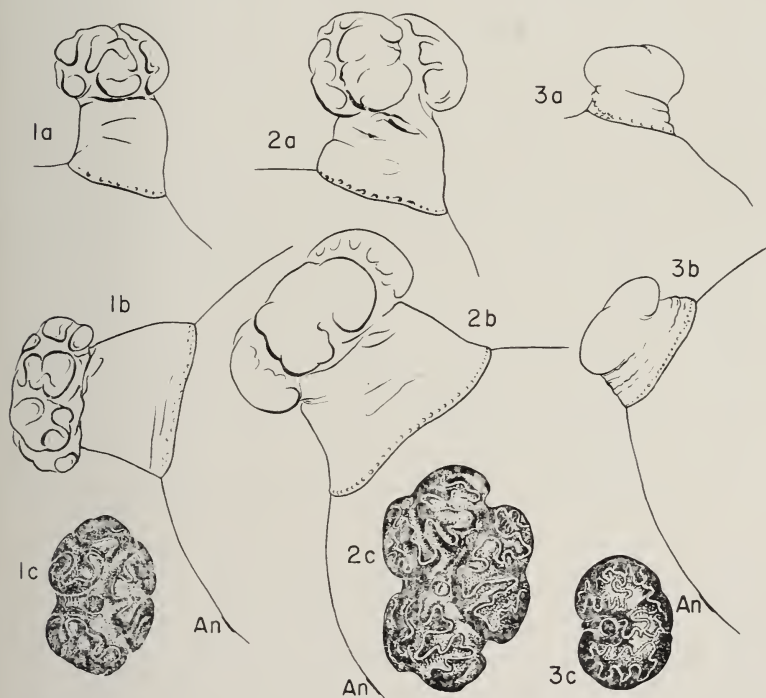
From the 13 cone-heads collected and confined, 12 larvae escaped and successfully formed puparia. When ready to pupate the larvae pierced the host's integument, generally in the vicinity of their breathing funnels, although one may have emerged from the anus. They were given a choice of

moist or dry, loosely packed earth with piles of dead grass for cover. The larvae were exceedingly active, humping frantically over the soil and exploring every part of the chamber. Some burrowed between or under loose, moist clods, but most of them settled under the grass on the moist surface. Within one to six hours all had become shortened and dark brown; puparia were formed a few hours later. One large specimen emerged from its host and formed a puparium within one hour.

As to the effects of the parasitism on the host, most of the cone-heads were active, singing and feeding nightly, until a day or two before the larvae emerged. A few hours before the exodus they became feeble and sluggish; two or three hours after even one or two larvae had emerged, the host was dead. Post-mortem examination showed a depletion of the fat body roughly proportionate to the number of parasites, but little apparent damage to the major organ systems. From these facts it is significant that larval survival is narrowly limited to those individuals within a particular host which reach maturity almost simultaneously. Two larvae emerged from one host within two hours of each other and pupated, while six other larvae, including one of the first instar, died inside the moribund host a few hours later. The total complement of three larvae escaped from another host and pupated successfully. This situation, involving larvae in staggered developmental stages within one host, is suggestive of a rather extended period of larviposition and a considerable endurance in the host-seeking first instar larvae. It might be added here that two heavily parasitized hosts also contained one and two specimens of a nematomorph, *Gordius* sp., coiled in their abdominal cavities. Further, three of the 1952 cone-heads each contained one nearly mature larva which Mr. Sabrosky has suggested as possibly *Beskia aelops*.

A female puparium is shown in figs. 7 and 8. Four male puparia vary from approximately 5.5 x 2.9 to 6.2 x 3.4 mm, and those of two females from 5.3 x 3.1 to 8.1 x 4.1 mm. The surface is finely wrinkled and the larval segmentation is fairly prominent. The line of dehiscence of the puparial cap, as well as a secondary fracture, is dotted in the figure.

Although Green figured the puparium of *Oestrophasia* (= *Euphasiopteryx*) *ochracea* in 1922, spiracular details of the three known puparia of the genus are included in text fig. 1 for ready comparison. The *brevicornis* puparium is dark mahogany with the spiracular tubercles a shining black, while those of *ochracea* and *depleta* are a dull brick red with subshining black tubercles. In all three species the tubercles are basally enlarged and well separated, *depleta* being the most extreme in these features. The tubercles of *ochracea* arise slightly above the longitudinal puparial axis, but in *depleta* they arise obliquely from the



Text figure 1. Comparison of spiracular details of the three known puparia of *Euphasiopteryx*. Fig. 1, *E. ochracea* (Bigot); a, ventral aspect of right spiracular tubercle; b, lateral aspect of same, An, anus; c, detail of spiracular plate. Fig. 2, *E. depleta* (Wied.), a, b, c, same as fig. 1. Fig. 3, *E. brevicornis* (Tns.), a, b, c, same as fig. 1. (x44).

posterior dorsal surface. In *brevicornis* the tubercles arise from an intermediate position well above the axis. The serpentine pattern of respiratory pores on each spiracular plate is raised in *ochracea* and *depleta*, and is divided into three groups which are only vaguely indicated in some specimens of *brevicornis*. These groups in *depleta* are separated by much deeper grooves than in *ochracea*. The stigmatic scar is fairly prominent and the anus is remote from the tubercles in all three species.

All puparia of *brevicornis* were formed in the laboratory essentially under normal seasonal temperatures. Two were obtained on 21 Aug., 1951, and ten more between 5 and 12 Aug., 1952. Each year the puparia were kept at about 23° C for a little over two months, held at 8° for two more months, then returned to 23°. Of the 1951 puparia, one female emerged on 10 March, 1952; the other, also a female, succumbed to mold shortly before emergence. Of the 1952 puparia, two males emerged after 11 days, and one male and one female emerged after 12 days, all before being placed in the cold room. The remaining six succumbed to mold and anthomyiid larvae in the insectary after cold treatment. Three of these contained fully formed flies, at least one of which was a female. Townsend (1936) cited a case of *E. ochracea* (Bigot) adults emerging in October, 12 days after the puparia were collected in Dallas, Texas. According to Wolcott (1951) the pupal stage of "*E. australis* (Tns.)" in Brazil lasts for ten days.

From these records it is evident that a diapause induced by winter cold is not necessary for adult development. On Cape Cod, adults of both *Neoconocephalus robustus* and *ensiger* have been taken at least until early October, while adults of several other likely orthopteran hosts, such as the katydid, *Amblycorypha oblongifolia carinata* R. & H., and the common cricket, *Acheta assimilis* F., live beyond mid-November in many seasons. In the vicinity of Dallas, the closely related *N. triops* (L.) has been collected in mid-December (Rehn and Hebard, 1944), and there are certainly many other possible hosts available beyond this date. With the probable capacity for a four to five week life cycle as far north as Cape Cod, this parasite could well produce

at least two generations a year on adult Orthoptera alone. It can and probably does pass the winter in the puparium, although nothing is known of the mating habits and survival capabilities of the adult flies.

In an effort to fill in the range and determine the host preferenda of these little-known flies, 15 specimens of *N. r. robustus* in the Museum of Comparative Zoology, from Cape Cod to Long Island, were examined for the presence of larval breathing holes. Similarly examined were 176 specimens, representing nine other species of *Neoconocephalus* from Massachusetts to Minnesota, Texas, and Florida, together with 26 Florida specimens of the related genera *Belocephalus*, *Pyrgocorypha*, and *Homorocoryphus*. In addition, large numbers of Orthoptera have been collected in East Brewster for anatomical studies over the past five years, and lately re-examined. These have included such likely hosts as *N. ensiger* (Harris); the conocephaline, *Orchelimum vulgare* Harris; the phaneropterine, *Amblycorypha oblongifolia carinata* R. & H.; and the common cricket, *Acheta assimilis* F. All of these examinations proved negative except for a single male of *N. ensiger*, collected by Richard Dow in Needham, Mass., 7 Aug., 1936, which bore the characteristic larval breathing hole in the left pleural membrane of the sixth abdominal segment. After softening the specimen a half-grown larva, with the first instar exuviae adhering to the funnel, was dissected out. On comparison with equivalent material under study, there is little doubt that *E. brevicornis* also parasitizes *N. ensiger*.

C. W. Sabrosky has checked the ranges of the two subspecies of *E. brevicornis* against those of the two subspecies of this particular host, *N. r. robustus* and *r. crepitans*, and informs me that the ranges show no significant coincidence. Therefore, until further evidence is available, it is assumed that the two subspecies of *brevicornis* must utilize additional hosts, at least in other areas of the range, but one or more of the ten other species of *Neoconocephalus* are probably favored. The question as to whether or not only adult Orthoptera are parasitized remains unanswered. Should the adults of a certain species

be the only host in a particular area, either the pupal stage or the adult life must be rather extended; on the other hand, if nymphal stages are also attacked, the host attrition must be considerable in favorable seasons.

Since all evidence has shown the genus to have a predilection for nocturnal orthopteran hosts, it is not surprising that, in the laboratory at least, the adult flies are also nocturnal. Wolcott (1951) has reported that "*E. australis*" adults hid in the darkest part of their cage during the day, but were unusually active at night. At present I can only confirm his observations and add that, during six years of occasional general collecting in the East Brewster area, I have never seen an adult fly. Many specimens seen by Mr. Sabrosky were collected at night, a further hint, but not proof, of nocturnal habits. Although much of the evidence cited above on range and host preference is either negative or purely circumstantial and speculative, it does explain the rarity and obscurity of these flies as well as their extremely local occurrence.

I extend my appreciation to C. W. Sabrosky of the Bureau of Entomology and Plant Quarantine for furnishing some of the pertinent references included, and especially for identification of the fly and description of the new subspecies, without which this information would be of little value. He made available for comparison the puparia of *E. ochracea* and *australis*, details of which are shown in text fig. 1. I also wish to thank Prof. H. J. Reinhard, of the Agricultural and Mechanical College of Texas, for his part in assisting in the identification.

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NEW DATA ON THE HABITS OF
CAMPONOTUS (MYRMAPHAENUS) ULCEROSUS
WHEELER

BY WILLIAM STEEL CREIGHTON
Department of Biology,
College of the City of New York

In June 1951 the writer published, in this Journal, an account of the habits of *C. (M.) ulcerosus*. Since that time eight more colonies have been observed and additional data have been secured on the habits of this remarkable ant¹.

The truncated head of the major worker of *ulcerosus* has suggested to some myrmecologists a relationship with the subgenus *Colobopsis*. This view is unsatisfactory from a structural standpoint, for the two subgenera actually have little in common. Nor did it seem likely, since *ulcerosus* is a ground-dweller, that the head of the major could be used in phragmosis. It is now certain, however, that the major worker of *ulcerosus* does function as a door and does close the nest entrance with the front of the head in a fashion essentially similar to the phragmotic major of *Colobopsis*.

This is possible because *ulcerosus* constructs a carton shield at the nest entrance. In this shield is a single aperture which closely approximates, in size and shape, the truncated portion of the head of the major. The shield is made of a mixture of earth and bits of vegetable detritus. The shield is so fragile that it usually cannot be lifted away from the nest entrance intact and it is sometimes destroyed by a heavy rainstorm. The shield may be flat, dome-shaped or tubular. In the dome-shaped and tubular shields the length is from ten to fifteen millimeters and the diameter from seven to ten millimeters. Since the aperture is notably smaller, it forms a bottle-neck which the head of the major can close.

The major of *ulcerosus*, when acting as a door, lets the other members of the colony in and out by backing away

¹ This work was done on a Guggenheim Fellowship for 1951-52.

from the aperture. In this respect it behaves essentially as does the major of *Colobopsis*. There are, however, a number of interesting differences in the process. When the head of the major of *Colobopsis* is serving in its phragmotic capacity, the only portions of it presented to the exterior are the jaws and the truncated anterior face. The antennae are folded back against the sides of the head and they are well removed from the exterior: it is difficult to see how they could receive tactile stimuli. This may be why Wheeler (Bull. Amer. Mus. Nat. Hist., Vol. 20, No. 10, p. 154, 1904) was unable to elicit any response when he attempted to cause the withdrawal of the *Colobopsis* major by touching the exposed portion of the head with a pin or straw. The head of the major of *ulcerosus*, when in the phragmotic position, can readily receive tactile stimuli with the antennae. For these parts are not concealed, but held so that each funiculus lies at one side of the aperture. The returning workers touch the exposed antennae of the occluding major with their own antennae to secure entry for, when thus stimulated, the major withdraws its head from the aperture. This same response can be elicited by touching the antennae of the occluding major with a bit of grass. The major of *ulcerosus* is capable of a rather surprising range of behavior when acting as a guard. As a general rule a strange ant can walk across the face of the *ulcerosus* major, when the latter has assumed the phragmotic position, without producing any visible response. Occasionally, however, the major will seize the strange ant in its jaws and jerk it into the nest, where it is, presumably, killed. Furthermore, the major of *ulcerosus* does not always take a position where its head blocks the entrance. During periods when little traffic is passing the "door", the major on guard often remains well inside the carton, with only the tips of the antennae showing at the aperture. From this position it can pop into place instantaneously, which it does if a strange ant walks onto the shield. If foraging has ceased and there are no strange ants in the vicinity, the major may retreat so far from the aperture that it cannot be seen when a beam of light is thrown through that opening. It is of interest to note that the major of *ulcerosus* is not limited to serving

in a phragmotic capacity only. Some of the majors regularly leave the nest to forage with the medias and minors.

A few other observations may be added. Workers returning to the nest always go in through the aperture head-first. They will do so even when this involves considerable struggle with what they are carrying. In the event that some strange ant is on or near the shield, the returning *ulcerosus* workers make no effort to enter the nest. They will wander about nearby until the intruder leaves, at which time they will secure entry to the nest in the usual fashion. It is clear that *ulcerosus* is a very timid ant. It is much afraid of several smaller species, particularly *Xiphomyrmex spinosus insons*. If the two meet, the *Xiphomyrmex* will usually rob the *ulcerosus* worker of anything it is carrying. This may be the reason why the workers of *ulcerosus*, which are returning to the nest with food, will take a needlessly tortuous course over grass tufts. Such a course would minimize the chance for encounters with *Xiphomyrmex*, for the latter ant rarely leaves the surface of the soil when foraging.

Presented below are several records which add to the known range of *ulcerosus*:

ARIZONA: Huachuca Mountains, Carr Canyon, 5400'; Santa Rita Mountains, Sweetwater, 5800'; Chiricahua Mountains, Nat. Mon. Campground, 5400'.

CHIHUAHUA: Sierra de en Medio, Nogales Ranch, 5000'.

SONORA: Cerro San Jose (Naco) 5100'.

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TABLE OF CONTENTS

- The Indo-Australian Species of the Ant Genus *Strumigenys* Fr. Smith:
S. wallacei Emery and Relatives. W. L. Brown, Jr. 85
- First Records of the European *Mantis religiosa* (L.) from Maine.
W. L. Nutting 89
- Australian Carabid Beetles II. Some New Pterostichini. P. J. Darling-
ton, Jr. 90
- Taxonomic Notes on the Ant, *Camponotus cooperi* Gregg. R. E. Gregg 102
- Further Notes on North American *Epicauta*, with New Synonymy
(Colecop., Meloidae). F. G. Werner 105
- New England Records of *Ululodes* Currie (Neuroptera: Ascalaphidae).
G. H. Beatty, III 114
- A New Neotropical *Chrysops* (Diptera, Tabanidae). L. L. Pechuman 115
- Three New Species of Panorpidae (Mecoptera). F. Y. Cheng 119
- Larval Mites of the Genus *Eutrombidium* Attached to a Carolina
Locust. W. W. Judd 124
- A Gregarine, *Diplocystis*, in the Haemocoel of the Roach, *Blaberus*
craniifer Burm. W. L. Nutting 126

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No. 3

THE INDO-AUSTRALIAN SPECIES OF THE ANT
GENUS *STRUMIGENYS* FR. SMITH: *S. WALLACEI*
EMERY AND RELATIVES¹

BY WILLIAM L. BROWN, JR.

Museum of Comparative Zoology, Harvard University

This is another part of my continuing revision of the dacetine ant genus *Strumigenys*. Here are discussed three species of the *szalayi* group, one of which is described as new. The other species of the group will be treated in a later paper in the series. The abbreviations for measurements and proportions are explained in previous parts of the revision: see *Psyche* 60: 1 (1953). Deposition of certain types is indicated by capitals in brackets as follows: United States National Museum [USNM], Museum of Comparative Zoology, Harvard University [MCZ].

Strumigenys nidifex Mann

Strumigenys nidifex Mann, 1921, Bull. Mus. Comp. Zool. Harvard, 64: 464, fig. 23, all castes.

This very large, dark brown species is found only on a few of the larger islands of the Fijian Group. The original description permits easy recognition; the ant is larger than any other species known from the Indo-Australian area, although Mann's measurements are a bit too low. I have recently received specimens from Mr. N. L. H. Krauss taken at Navai, Viti Levu. It nests under stones, where it builds reticulately patterned nests with mud, or in rotten wood [USNM, MCZ].

Strumigenys wallacei Emery

Strumigenys Wallacei Emery, 1897, Term. Füzetek 20: 575, 578, pl. 14, fig. 7, worker.

¹ Published with a grant from the Museum of Comparative Zoology at Harvard College.

I have seen no specimens of this species, but Emery's figure and description show that it is very closely related to *S. opaca* sp. nov., described below. Emery's measurements are probably too low ("2 $\frac{3}{4}$ -3 mm."), and in his figure, the eyes may be portrayed as much too flat, judging from other related species. In the width of the head, form and pilosity of the antennal scapes, and other features, this species and *S. opaca* together form a subgroup distinct from the other *szalayii* relatives. Possibly *wallacei*, like *opaca*, may also lack the intercalary tooth of the apical fork. Of *wallacei*, Emery says the gaster is "nitida, nigra, basi rugosi-striata." In the new species, the entire first tergite is sculptured and opaque, and is deep red instead of black. As already mentioned, the difference in the eyes as portrayed in Emery's figure may not be reliable, so we shall have to await an opportunity to see types of *wallacei* before citing other distinctions between the two species. The types are either in the Emery Collection, Museo Civico di Storia Naturale, Genoa, or in the Hungarian National Museum, Budapest, or both. Type locality: Lemien Forest, near Berlinhafen, New Guinea.

***Strumigenys opaca* new species**

Holotype worker: TL 3.49 mm., HL 0.83 mm., ML 0.46 mm., WL 0.81 mm.; CI 86, MI 55. Occipital lobes overlapping pronotum by about 0.04 m., this amount not subtracted from TL.

Head in outline very much as in Emery's figure of *S. wallacei* (see above), very broad and similarly deeply excised posteriorly. Eyes larger, more convex and more strongly protuberant, also more anteriorly directed, than those shown for *wallacei* in Emery's figure. Actually, the eyes are situated on low protuberances, immediately in front of which run deep vertical preocular sulci; the latter continue onto the ventral surface of the head and join there to form the deep postoral sulcus. Antennal scrobes ending abruptly above the eyes. As the head is seen in direct dorsal view, the dorsolateral borders run well inside of the ventrolateral borders and are only very feebly indented at the level of the eyes. The perioocular structure is similar to that of *szalayii*, *nidifex*, etc., but differs in having the dorsolateral

borders only slightly indented above the eyes and in having the eyes themselves much larger and more protruding, more nearly prosopient.

Vertex evenly convex, feebly impressed in the middle; occipital lobes strongly depressed and nearly plane dorsally; broadly expanded both posteriad and laterad. Clypeus more than half again as broad as long, moderately convex, anterior border emarginate and weakly depressed in the middle.

Mandibles about as shown in Emery's *wallacei* figure, slightly depressed and very slightly broadened just at their insertions. Seen from the side, they tilt slightly dorsad and are feebly arched. Apical fork of two long spiniform teeth, subparallel and forming a U, the ventral tooth (L 0.10 mm.) about $\frac{2}{3}$ as long as the dorsal (L 0.15-0.16 mm.); no intercalary denticle. Preapical tooth slightly curved, spiniform, situated at approximately the apical third of the ML, its L ca. 0.10 mm.

Antennal scapes (straightline L about 0.60 mm.) very feebly bent posteriorly near the base, where they are very slender; apical half gradually incrassate, thickest at about the apical quarter, and gently arched so as to follow the contour of the sides of the head when in repose. This adaptation evidently compensates for the incomplete condition of the scrobes, and is seen in somewhat similar form in *szalayii*. Funiculus L 0.65 mm., the apical segment occupying just half this length; IV longer than I; II and III subequal, longer than broad, together not quite as long as I.

Anterior promesonotum gently convex, descending behind through the evenly concave posterior half of the mesonotum to the lower, extremely feebly convex (nearly straight in profile) propodeal dorsum; metanotal groove obsolete. Promesonotum seen from above with a very narrowly rounded and poorly developed anterior border; cervix with a median dorsal carinula. No traces of humeral angles or tubercles, humeral region gently convex, promesonotal suture obsolete. Propodeal teeth long (L ca. 0.12 mm.), set far apart, slender, acute, feebly diverging and elevated at an angle of about 35° from the plane of the propodeal dorsum. Infradental carinulae indistinct, becoming obsolete ventrad.

Petiolar peduncle slender, slightly longer than node. Node evenly rounded above, very slightly broader than long, with only very narrow, sublamellose vestiges of appendages posterodorsally, posterolaterally and ventrally. Postpetiole twice as broad as petiolar node, and higher and more bulky, subglobose, only slightly broader than long (L 0.20, w 0.25 mm.); spongiform appendages poorly developed, restricted to thin posterodorsal border and meager ventral and ventrolateral lobes.

Entire insect, except for shining mandibular apices, densely and finely sculptured and opaque; the sculpture predominantly punctulate as in other species of the genus, and similarly becoming more superficial and indistinct on the gastric dorsum, which, though largely quite opaque, becomes less definitely so toward the apex.

Dorsum of head, alitrunk and nodes with a sparse, inconspicuous ground pilosity of short, spatulate subappressed hairs. Clypeus with a medially directed fringe of spatulate hairs, about 9 or 10 on each side of the middle. Anterior border of scape with a regular row of stiff, apically-inclined oar-shaped hairs, becoming longer toward the scape apex; a similar row appears in Emery's figure of *wallacei*, but the individual hairs in *opaca* appear to have broader blades apically. Hairs on inner mandibular borders near base long, fine, subreclinate; those near apex longer, perpendicular. Abundant short subreclinate hairs along posterior borders of scapes. No specialized erect hairs on head or alitrunk. Short, erect, posteriorly-inclined clavo-spatulate hairs as follows: a pair on postpetiole; 3 pairs on basal gastric tergite; transverse rows of 4-6 hairs each on succeeding gastric segments, becoming smaller and finer toward extreme apex. Short fine hairs under gastric apex.

Color deep brownish-red; mandibles, legs, antennae and occipital lobes a trifle lighter and more yellowish.

Holotype [MCZ] selected from a nest series of 15 workers taken in rain-forest at Lankelly Creek in the McIlwraith Range, a few miles east of Coen, central Cape York Peninsula, Queensland during June, 1932 (P. J. Darlington: Harvard Australia Expedition).

Paratypes: [MCZ, USNM, Queensland Museum, etc.] the

remaining 14 workers from the type nest series are very uniform in structure and color, and quantitative variation is slight. TL 3.18-3.51, HL 0.78-0.85, ML 0.43-0.48, WL 0.75-0.81 mm.; CI 82-86, MI 54-57.

FIRST RECORDS OF THE EUROPEAN MANTIS RELIGIOSA (L.) FROM MAINE. — Aside from the persistent records from New York and Ontario, the last three years have produced numerous records of this insect in widely scattered localities in Vermont, Massachusetts, and Connecticut. Although only one specimen was reported in Sept. 1951, from Saco, Maine (Mrs. G. B. Nutting), the following 1952 records from York County, Maine indicate that it may now have a hold in that state: three specimens from Biddeford, 15, 18 Aug., and 6 Oct. (H. J. Edwards, A. Lowell, and J. Foran); one specimen from South Buxton, 10 Sept. (determined by Mr. A. E. Brower of the Entomological Laboratory, Augusta). The Biddeford records, along with numerous other "sightings", were largely from the business district, in yards, on window sills, parking meters, and the like. Although the males fly well, as do many females before they become gravid, this relatively rapid spread is probably due largely to long-distance shipments of hay and nursery stock containing their egg masses.

The average winter temperature of coastal and southeastern Maine is close to that of southern Ontario, but is definitely warmer than northeastern Ontario near the confluence of the Ottawa and St. Lawrence Rivers. Since this mantid is already well established in both these regions of Ontario, it is possible that it may eventually become a permanent resident over much of New England, including coastal Maine. — W. L. NUTTING, Biological Laboratories, Harvard University.

AUSTRALIAN CARABID BEETLES II.
SOME NEW PTEROSTICHINI

BY P. J. DARLINGTON, JR.

Museum of Comparative Zoology, Harvard University

This is the second of what I hope will be a continuing series of papers on Australian Carabidae. The first, with some information on sources of material and methods of work, appeared in *Psyche*, vol. 60, 1953, pp. 52-61. The present paper contains the descriptions of seven new Pterostichini of the Australian genera *Leiradira*, *Setalis*, *Trichosternus*, and *Notonomus*. Several of the new species either extend the known ranges of their genera or show unusual characters or variations. Except as otherwise stated, all the specimens here reported upon were collected by myself during the course of the Harvard Australian Expedition of 1931-1932.

Genus *Leiradira* Cast.

Leiradira alternans n. sp.

Of general form and appearance of previously known *Leiradira* (e. g. *auricollis* Cast.) but larger and narrower; color, including appendages, black or piceous (more rufous in recently emerged individuals) with outer antennal segments brown; rather shining, microsculpture faint, isodiametric on head, somewhat transverse on prothorax and elytra. *Head* normal for genus, .67 and .71 width prothorax in ♂ ♀ measured; antennae geniculate but with 1st segment shorter than usual in genus; frontal sulci deep, linear, somewhat curved and converging anteriorly, joined anteriorly by a variable but usually lightly impressed clypeal suture; surface impunctate. *Prothorax* appearing at least as long as wide but by measurement slightly wider than long; base about equal to apex; sides broadly arcuate, almost parallel 1/3 from apex, strongly sinuate just before base; basal angles right; lateral margins very narrow, consisting of marginal bead only, with usual setae at base

and about $1/3$ from apex; base subtruncate or slightly sinuate; apex subtruncate, with anterior angles very slightly advanced; sub-basal impressions in form of deep, somewhat elongate foveae, each connected with the margin posteriorly by a deep, curved impression; disc with median line light, transverse impressions obsolete, surface impunctate. *Elytra* $1/5$ or $1/4$ wider than prothorax, not or moderately narrowed anteriorly (variable), with sides subparallel or slightly arcuate at middle, sinuate before apex, then rather narrowly and almost conjointly rounded; basal margin either entire and conspicuously lobed or interrupted at 1st, 3rd, and 5th intervals (variation individual, not geographical), approximately rectangular and strongly elevated at humeri; striae rather deep, entire, impunctate, but finely granular at bottom; intervals alternately wide and narrow (1, 3, 5, and 7 wide), moderately convex on disc, more so laterally and apically; 3rd interval 2, 3, or 4 punctate, the punctures somewhat irregular in position as well as number; 8th and 9th intervals narrow and convex; fragments of a very narrow 10th (submarginal) interval posteriorly. Prosternal process not margined, declivity flat, without setae; metepisterna short; sides of sterna not much punctate, but sides of abdomen especially anteriorly extensively punctate, with the segments more or less impressed near sides. Fifth segment of tarsi without accessory setae below. Male with anterior tarsi a little dilated, first 3 segments biserially squamulose; ♂ with 1, ♀ with 2 setigerous punctures each side last ventral segment. Length 14-16.5; width 4.1-5.0 mm.

Holotype ♂ (M. C. Z. Type No. 29,016) and 3 paratypes from Malanda, Atherton Tableland, North Queensland, Nov. 7 and 8, 1950, collected by Dr. W. L. Brown in rotten logs in rain forest; and also the following additional paratypes: 3, Millaa Millaa, Atherton Tableland, about 2,500 ft. altitude, April, 1932; and 1, Lake Barrine, Atherton Tableland, about 2,300 ft. altitude, April, 1932.

This, the first *Leiradira* to be recorded from North Queensland, is very distinct from all species previously assigned to the genus. The alternation in width of the elytral intervals is alone enough to distinguish it from, for example, *L. auricollis* Cast. and all other known species of the

genus (keyed out and discussed by Tschitscherine in *Horae Soc. Ent. Rossicae*, Vol. 32, 1898, pp. 39-46), and there are many other specific differences. It is not so easy to say just how the new species is related to "*Notonomus*" *opacistriatus* Sl., which Sloane eventually decided was not a *Notonomus* (*Proc. Linn. Soc. New South Wales*, Vol. 38, 1913, p. 409), and which is from Cairns, below the Atherton Tableland. The two species are apparently related, but different. As compared with the description of *opacistriatus*, the present new species agrees in many significant details including alternation in width of the elytral intervals and opacity of the elytral striae, but Sloane's species is evidently a wider, less convex, somewhat differently shaped insect. This is shown by the measurements he gives (16 by 5.5 mm. — a 16 mm. specimen of the present new species would be less than 5 mm. wide), by his statement that his species is oval and rather depressed while the present new species is subparallel and rather convex, and by his statement that in his species the prothoracic margins (as distinguished from the lateral channels) are narrow but wider toward the base while the present new species has no margins except the lateral channels, this being consistent with the new species being a narrower and more convex insect. I think that "*Notonomus*" *opacistriatus* Sl. will probably prove to be a link between *Leiradira* and more normally formed pterostichines, but I do not care to place it formally without seeing it.

Genus *Setalis* Cast.

Setalis sloanei n. sp.

Almost exactly like *Setalis niger* Cast. in form and appearance, but very much smaller; shining black, legs brownish piceous, antennae reddish brown; upper surface slightly silky but without distinct microsculpture. *Head* .62 and .59 width prothorax in ♂ ♀ measured, almost as in *S. niger*, swollen posteriorly, with small but even more abruptly prominent eyes; frontal impressions deep, irregular, somewhat converging, joined anteriorly by a sharply defined slightly emarginate clypeal suture; surface impunctate. *Prothorax* 1/4 wider than long, narrowed anteriorly, scarcely so posteriorly; base about 2/5 wider than apex: sides

broadly arcuate anteriorly, straight or even faintly sinuate and only slightly converging posteriorly; basal angles almost right but narrowly rounded; base broadly sinuate; apex subtruncate or very broadly emarginate, with anterior angles not advanced; lateral margins very narrow, with usual setae at base and about $1/4$ from apex; disc normally convex; sub-basal impressions short, deep, linear, irregular or subpunctate; a group of punctures (sometimes only 1 puncture) between sub-basal impression and lateral margin; disc otherwise impunctate, with median line light, transverse impressions vague; base not distinctly margined, apex margined at sides but not at middle. *Elytra* about 1.6 wider than prothorax; sides subparallel, slightly sinuate before apex, then conjointly rounded; basal margin entire, bent forward and forming acute angles (more acute than in *niger*) at humeri; striae entire, deep, impunctate; intervals slightly convex on disc, more so laterally and apically; dorsal intervals equal, 3rd impunctate; 6th interval a little narrower especially at extremities; 7th still narrower and abbreviated posteriorly (ending near apical $1/4$); 8th very narrow and a little more abbreviated (but not so short as in *niger*); 9th with usual ocellate setigerous punctures; a vague 10th interval present but not sharply separated from marginal trough. Prosternal process strongly margined (not so in *niger*), without setae; metepisterna short, they and sides of anterior ventral segments more or less punctate, but body below almost impunctate; last 3 ventral segments deeply transversely sulcate basally. Male with anterior tarsi moderately dilated, first 3 segments biserially squamulose; last ventral segment of both sexes with 1 conspicuous puncture (sometimes doubled) each side of middle. Length 6-7; width 2.4-2.8 mm.

Holotype ♂ (M. C. Z. Type No. 29,015) and 10 paratypes all from National Park, McPherson Range, South Queensland (on New South Wales border), 3,000-4,000 ft. altitude, March, 1932.

In appearance this new species is a diminutive of *Setalis niger* Cast., but the size difference is great (*niger* is 10-12 mm. long), and there are some definite structural differences: the new species has more acute humeri, less abbreviated eighth elytral intervals, and a strongly margined pro-

sternal process. (The M. C. Z. possesses a good series of *niger* from several localities in northern New South Wales and southern Queensland.) The new species very much resembles certain *Setalimorphus*, especially *S. regularis* Sl. (which we have), but differs in the unusual modification of the seventh and eighth elytral intervals.

Genus *Trichosternus* Chd.

***Trichosternus relictus* n. sp.**

Rather elongate in genus, subparallel, normally convex; piceous black with purplish reflections especially on head, pronotum, and elytral margins (sometimes brassy on head and pronotum); legs piceous; antennae with 3 basal segments piceous, other segments pubescent and progressively paler brown; head and pronotum shining, with microsculpture fine and lightly impressed (nearly isodiametric on head, somewhat transverse on pronotum); elytra (except margins) duller, with microsculpture fine but deeply impressed, isodiametric; but marginal trough of elytra shining, with microsculpture faint; whole insect virtually impunctate above and below, except for punctures of fixed setae. *Head* large, .77 and .85 width prothorax in ♂ ♀ measured, but appearing wider; mandibles rather short; eyes small but convex, slightly more prominent than genae; genae barely longer than eyes, convex in profile; 2 setae above each eye; frontal impressions parallel, not deep, rather irregular; mentum deeply emarginate, with tooth rather broad, short, channeled; labium bisetose; paraglossae glabrous; inner lobe of maxilla strongly curved in at apex, with inner margin densely ciliate. *Prothorax* nearly $\frac{1}{3}$ (width/length 1.33 and 1.31 in ♂ ♀ measured) wider than long, widest about $\frac{1}{3}$ from apex; base slightly narrower than apex; sides only moderately arcuate anteriorly, slightly arcuate or straight or at most faintly sinuate posteriorly; basal angles narrowly rounded, obtuse; base broadly and shallowly emarginate; apex scarcely emarginate, with anterior angles slightly advanced; lateral margins rather narrow anteriorly, a little wider posteriorly, each with a seta near (just before) base and at about apical $\frac{1}{3}$; baso-lateral impressions irregularly rounded, each with whole bottom occupied by a low tubercle; disc normally

convex, with usual middle line and transverse impressions; base and apex margined at sides but not at middle. *Elytra* subparallel, only slightly narrowed anteriorly, rather long (in genus), only about $1/5$ or less wider than prothorax (appearing scarcely wider); basal margin entire, strongly (almost rectangularly) angulate at humeri but not distinctly dentate; sides almost straight, then increasingly arcuate, without distinct subapical sinuations, to right or slightly obtuse sutural angles; striae well impressed, punctate; intervals all rather strongly and almost equally convex, 3rd with single setigerous puncture very near apex, 5th with 2 punctures, set respectively well forward (about as far from base as from suture) and well back (punctures somewhat variable in position and single punctures sometimes absent). Prosternal declivity and apex of mesosternum setose; last ventral segment 4-setose (2 setae each side) in both sexes. Male with anterior tarsi normally dilated, first 3 segments biserially squamulose. Length 23-28; width about 7.4-8.3 mm.

Holotype ♂ (M. C. Z. Type No. 29,010) and 19 paratypes all from near the town of Margaret River, southwestern division of Western Australia, October, 1931, taken under logs on the ground in eucalyptus woods.

This is the first species of the whole *Trichosternus* complex to be found in Western Australia. It is a very distinct species, and I am unwilling to assign it to any recognized subgenus of the genus, much less to say to what other species it is most closely related. Superficially it is something like *T. (Castelnaudia) speciosus* Sl., but is more parallel-sided, with sides of prothorax not or at most faintly sinuate, and with elytral intervals all about equally convex.

***Trichosternus soror* n. sp.**

Form average in genus, small, rather convex; piceous black, upper surface purplish, color brightest on head and pronotum; legs piceous; antennae with 3 basal segments reddish piceous, outer ones browner; head and pronotum shining, with microsculpture fine, light, about isodiametric on head, slightly transverse on pronotum; elytra duller but still somewhat shining especially on tops of subcostate intervals, with more deeply impressed, fine, isodiametric

microsculpture; sides of elytra (8th intervals) dull, with almost granular microsculpture. *Head* $4/5$ (.79 and .81) width prothorax but appearing wider; mandibles moderately long; eyes small but convex, scarcely more prominent than genae; genae slightly shorter than eyes, convex in profile; 2 setae over each eye; frontal impressions parallel, not deep, irregular; mentum tooth bifid. *Prothorax* subcordate, about $1/5$ or $1/4$ wider than long (width/length 1.20 and 1.27), widest about $1/3$ from apex; base a little (about $1/10$) narrower than apex; sides moderately arcuate anteriorly, then straight and converging posteriorly, then moderately sinuate before almost-right posterior angles; base scarcely emarginate at middle, slightly oblique at sides; apex very broadly and slightly emarginate, with anterior angles slightly advanced; lateral margins rather narrow anteriorly, very narrow posteriorly, each with a seta at basal angle and another about $1/3$ from apex; baso-lateral impressions normal, sub-linear, somewhat wrinkled but not distinctly punctate; disc normal; basal area longitudinally, irregularly striate; base and apex not distinctly margined except near sides. *Elytra* suboval, narrowed anteriorly, a little more convex than usual in genus, $1/4$ to $1/3$ wider than prothorax; basal margin entire, almost rectangularly angulate and subdentate at humeri; sides broadly rounded; subapical sinuations almost absent; sutural angles nearly right but slightly blunted; striae fine, defined mostly by slope of intervals, rather finely punctate; intervals 1 to 7 strongly convex, subcostate, almost equal in height except 7th higher and costiform basally; 8th interval about same width but only slightly convex and very dull; 9th (sub-marginal) interval narrow and shining; each 3rd interval with 3 setigerous punctures spaced in posterior half (none anteriorly). Prosternal process and mesosternal declivity setose; sides of metasternum (not episterna) with a few coarse punctures but body below otherwise virtually impunctate. Male with front tarsi not dilated and with no sexual pubescence; last ventral segment of male with 1 strong setigerous puncture each side and several smaller ones in from margin near middle, of female with 2 setigerous punctures on one side and three on other. Length about 21; width about 6.7 mm.

Holotype ♂ (M. C. Z. Type No. 29,011) and 1 ♀ paratype both from Millaa Millaa, Atherton Tableland, North Queensland, about 2,500 ft. altitude, April, 1932, in "scrub" (rain forest).

The unmodified front tarsi of the male set this species apart from most others of the genus. Otherwise the new species somewhat resembles *T. (Castelnaudia) nitidicollis* Cast. and its allies (of South Queensland etc.), but differs in having the discal elytral intervals (1 to 6) almost equally elevated instead of alternately so, and it differs also in various minor characters. Unmodified male tarsi occur in *T. subvirens* Chd. and *T. simplicipes* Sl. (of South Queensland) but in these species the mentum tooth is rounded, not bifid as in the present new species, and there are many other specific differences. For these reasons I doubt if the new species is very closely related to any previously known one. This species is, of course, very small within its genus.

Genus *Notonomus* Chd.

The following three new species of *Notonomus* go with *N. doddi* Sl. and *saepestriatus* Sl. (both known to me only by description) to form a subgroup of the "kingi-group" of Sloane's second revision of the genus (Proc. Linn. Soc. New South Wales, Vol. 38, 1913, pp. 404-449, esp. pp. 437-440). The subgroup is apparently confined to North Queensland (known from the Atherton Tableland and Mt. Spurgeon) and is characterized by having the posterior-lateral setigerous puncture of the margin of the pronotum on the margin at the basal angle; the elytra fully and strongly striate, with the third interval not more than (but sometimes less than) 2-punctate and the fifth and seventh intervals impunctate, and the eighth interval (the tenth in the species with extra intervals) narrow and convex; the metepisterna short; the intercoxal declivity of the prosternum flat and without setae; the tarsi not striate above; the posterior tarsi with the first segment rather long (but not quite so long as the next two together), with the claw-segment glabrous below; and with secondary sexual characters normal, that is the male with one seta on each side of the last ventral segment and the female with two setae each side, and the male with the anterior tarsi moderately

dilated and with the first three segments biserially squamulose below and the female usually with these tarsi unmodified — but see under *N. masculinus*, below. The species of this subgroup differ remarkably among themselves in some other characters, as the following key shows. Incidentally, Mt. Spurgeon is probably the most northern locality at which any *Notonomus* has been found.

Key to the species of *Notonomus* of the *doddi* subgroup

1. Elytron with 9 normal intervals plus a narrow 10th submarginal one which does not reach base 2
- Elytron with 11 intervals plus the narrow submarginal one (7th interval triplicate) 4
2. Head and pronotum shining; elytral intervals not catenulate *spurgeoni* n. sp.
- Head and prothorax dull; elytral intervals catenulate 3
3. Pronotum transversely striolate; elytron with 3rd interval 2-punctate *doddi* Sl.
- Pronotum longitudinally striolate; elytron with 3rd interval impunctate *masculinus* n. sp.
4. Pronotum shining; elytral intervals not much catenulate (only 2nd interval crenulate on apical declivity) *saepistriatus* Sl.
- Pronotum dull; elytral intervals more extensively subcatenulate *triplicatus* n. sp.

***Notonomus spurgeoni* n. sp.**

With characters of *doddi* subgroup (above); a little more slender than usual but otherwise of about average form and convexity for genus; purple or purplish above, piceous below, with appendages piceous to brownish-piceous; rather shining; microsculpture fine and light (heavier on elytra), isodiametric in head and elytra, perhaps slightly transverse (but faint) on pronotum. *Head* normal for genus, .70 and .67 width prothorax in ♂ ♀ measured. *Prothorax* a little wider than long (width/length 1.12 and 1.20 in ♂ ♀ measured) but appearing as long as wide; base about 1/10 wider than apex; sides broadly and rather weakly arcuate for most of length, then straight or faintly sinuate near base;

posterior angles rather variable, slightly obtuse or right, more or less denticulate; base slightly sinuate; apex slightly and broadly emarginate, the anterior angles scarcely advanced beyond the line of the emargination, narrowly rounded; lateral margins very narrow, scarcely wider toward base; baso-lateral impressions normal, linear, impunctate, reaching base; middle line distinct, transverse impressions sub-obsolete; disc impunctate, with lightly impressed transverse wrinkles; basal and apical marginal lines widely interrupted at middle. *Elytra* subparallel, not or slightly narrowed anteriorly, not much wider than prothorax (1.13 and 1.17 as wide in measured ♂ ♀); basal margin entire; strongly (almost acutely) angulate and subdentate at humeri; striae deep, impunctate; intervals convex, not catenulate (except extreme lateral ones), 3rd 2-punctate, the punctures near middle of length and behind apical 1/4. Length 13.5-18.0; width 4.0-5.3 mm.

Holotype ♂ (M. C. Z. Type No. 29,012) and 16 paratypes all from Mt. Spurgeon, North Queensland, 3,500-4,000 ft. altitude, July, 1932, in "scrub" (rain forest).

This new species is sufficiently compared with others in the key, above.

***Notonomus masculinus* n. sp.**

With characters of *doddi* subgroup (above); a little broader than usual but otherwise of about average form for genus; black, faintly purplish above, greenish at middle of pronotum, appendages black to piceous; head and pronotum dull, elytral intervals more shining; reticulate microsculpture very fine and isodiametric on head and elytra, replaced by close longitudinal strigae on pronotum. *Head* normal, not large, .66 and .65 width prothorax in ♂ ♀ measured. *Prothorax* 1/4 to 1/3 wider than long; base 1/5 or less wider than apex; sides moderately arcuate, then straight and converging to obtuse but denticulate posterior angles; base slightly sinuate; apex broadly emarginate, with anterior angles not advanced beyond line of emargination, narrowly rounded; lateral margins very narrow; baso-lateral impressions linear; disc almost flat, impunctate, with middle line distinct but transverse impressions obsolete; base and apex not margined at middle. *Elytra*

rather broad, about $1/5$ wider than prothorax; not much narrowed anteriorly; sides very broadly arcuate; anterior margin entire, about rectangular and at most finely dentate at humeri; striae deep, not visibly punctate; intervals convex, strongly catenulate, 3rd impunctate (in all specimens). Secondary sexual characters of δ normal, but ♀ with anterior tarsi, though not much dilated, with first segment conspicuously biseriately squamulose below. Length about 17.5-20.5; width 5.4-6.6 mm.

Holotype δ (M. C. Z. Type No. 29,013) and 4 δ 1 ♀ paratypes all from Millaa Millaa, Atherton Tableland, North Queensland, about 2,500 ft. altitude, April, 1932. Also 2 specimens (δ ♀), not types, from Herberton, Atherton Tableland, July, 1951, collected by and received from Dr. J. G. Brooks.

This species too is sufficiently compared with others in the key, above. The carrying over into the female sex of a part of the clothing of the male front tarsus is unique among Carabidae, so far as I know. Since the squamules are conspicuously present on the first segment of both front tarsi of two females from different localities, I suppose that this is a specific character and not an individual abnormality.

Notonomus triplicatus n. sp.

With characters of *doddi* subgroup (above); form about average for genus; piceous, dull bronze above, appendages piceous to brown; entire upper surface rather dull, with fine, well impressed, isodiametric microsculpture. *Head* normal, not large, .65 and .63 width prothorax in δ ♀ measured. *Prothorax* $1/4$ to $1/3$ wider than long; base about $1/5$ or less wider than apex; sides moderately arcuate for most of length, nearly straight and converging near base; posterior angles obtuse but subdenticulate; base slightly sinuate; apex broadly emarginate, with anterior angles not advanced beyond line of curve of emargination, narrowly rounded; lateral margins narrow only slightly wider basally; baso-lateral impressions linear; disc only slightly convex, impunctate, with middle line distinct but transverse impressions indistinct; base and apex not margined at middle. *Elytra* moderately broad, subparallel, not

much narrowed anteriorly, about $1/8$ or $1/7$ wider than prothorax; anterior margin entire, rectangular and subdentate at humeri; striae deep; intervals convex, subcatenate or catenate especially posteriorly, 7th tripled, 3rd with 2 setigerous punctures, near middle of length and behind posterior $1/4$. Length about 18; width about 5.6 mm.

Holotype ♂ (M. C. Z. Type No. 29,014) and 3 paratypes (♂ ♀ ♀) all from Lake Barrine (type) and the nearby town of Yungaburra, Atherton Tableland, about 2,300 ft. altitude, April, 1932.

Like the preceding ones, this new species is sufficiently compared with previously known species in the key, above. In many ways it is much like the preceding new species (*masculinus*), but it differs strikingly in the tripling of the seventh interval and in microsculpture, and the female has normal, unmodified front tarsi.

TAXONOMIC NOTES ON THE ANT,
CAMPONOTUS COOPERI GREGG

BY ROBERT E. GREGG

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Several years ago I described an unusual Central American ant, naming it *cooperi* and placing it in the genus *Camponotus* (Gregg, 1951). The specimen, a single alate female, was sent to me by Dr. W. L. Brown, for description and illustration, together with some comments on its affinities. Since the facies of the ant is astonishingly like those of *Camponotus*, and particularly because of its close similarity to members of the subgenus *Myrmostenus*, both of us concluded it belonged to these groups. It was accordingly placed in the genus *Camponotus* and as a new species in the above subgenus which Emery had erected in 1920 to contain several South American species previously described by him. Unfortunately, all of these ants are known only from the female caste, no workers having as yet been found (Emery, 1925).

Recently, Dr. Brown checked the type of *cooperi*, and it now develops that the ant cannot possibly be considered a form of *Camponotus* owing to the fact that the antennae are 10-segmented instead of having 12 articles characteristic of the above named genus. The description and figure also give 10 as the antennal joint number, so the mistake obviously lies in our interpretation of the relationships of *cooperi*. The slip is attributable to the amazing similarities in habitus (except smaller size) between the new ant and those in the subgenus *Myrmostenus*, which resemblances are probably to be regarded as the products of convergent evolution.

Dr. Brown has offered the following statement (in litt.) with respect to his current view on the matter. "Although the proventriculus has not been dissected out for examination, it appears very probable that this species [*cooperi*]

really belongs in the vicinity of *Myrmelachista*, particularly of the subgenus *Decamera* Roger. The species described by Menozzi (1935) as *Aphomyrmex (Neaphomus) goetschi* from Chile also falls close into this group, according to his characterization and Wheeler's key of 1922. The genera of the tribe Myrmelachistini appear to be in confusion, partly due to the unsatisfactory nature of the antennal club as a stable group character. A female of *Myrmelachista (Decamera) paderewskii* Forel in the Museum of Comparative Zoology is almost as large as the *cooperi* female, but is much less aberrant in many ways. At present it appears best to consider Menozzi's *goetschi*, with *cooperi*, as members of an independent genus bearing the name *Neaphomus* Menozzi."

There is no doubt that *cooperi* must be removed from *Camponotus* and placed in another, and more appropriate, genus, and it seems advisable to do so without involving any new generic names at this time, even though the group chosen may be shown subsequently to be an artificial assemblage. However, I do not concur with Dr. Brown's treatment quoted above, which would produce certain nomenclatural changes, but feel that in view of the unsatisfactory nature of the classification of the various species concerned, it is much safer to make as few shifts as possible, and to place the ant in question in the genus *Aphomyrmex* into which group it falls with no difficulty according to Wheeler's key to the genera written in 1922. Wheeler expressly states that the females of this genus have 10-segmented antennae, and since no workers accompanied the specimen of *cooperi*, it is impossible to state what their antennal condition may be and we are forced to rely entirely upon the segment number of the female. Furthermore, while the genus *Myrmelachista* (subgenus *Decamera*) possesses 10-jointed antennae, the genus as a whole has a differentiated club, which is absent from the *cooperi* female, the joints of same showing a gradual increase in thickness toward the tips of the antennae. And finally, I am informed by Dr. Creighton that females of the genus *Myrmelachista* he has seen look much like those of *Iridomyrmex* in general appearance (despite the difference in subfamily allocation), which would make those species

decidedly unlike the *cooperi* female.¹

Wheeler gives the distribution of *Aphomomyrmex* as Ethiopian and *Myrmelachista* as Neotropical, but this is no proof the former could not occur in the New World tropics, especially as the fauna of that region is far from exhaustively studied. Moreover, Menozzi (1935) described a Neotropical *Aphomomyrmex* nearly twenty years ago, so it is not unknown from this side of the Atlantic. And the genus which Dr. Brown proposes, *Neaphomus*, has been regarded as a subgenus of *Aphomomyrmex*.

In view of the above discussion, therefore, and particularly since we are as yet unable to associate the worker caste with the female of the species concerned, I submit the following correction, and the synonymy then should read:

***Aphomomyrmex* (*Neaphomus*) *cooperi* (Gregg)**, new combination for *Camponotus* (*Myrmostenus*) *cooperi* Gregg, 1951, *loc. cit.*

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¹In contrast, Dr. Brown believes, "there is no essential difference in the clavation of the antennae between *cooperi* and certain *Dacampa* species. In fact, *cooperi* may be said to have stronger and more definite clavation of the funiculi than does *M. (D.) paderewskii* female. Furthermore, certain species of *Myrmelachista* (eg. *M. skvarrae*) are smaller replicas of *N. goetschi* in all essential habitus characters, including the lengthened head. Thus, while to Creighton some *Myrmelachista* females may look like *Iridomyrmex* of the same caste . . . , at least some have an appearance very much different from that of *Iridomyrmex*."

FURTHER NOTES ON NORTH AMERICAN
EPICAUTA, WITH NEW SYNONYMY
(COLEOP., MELOIDAE)

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The availability of series of several of our species of *Epicauta* has made possible a more thorough study of the species involved than has been possible before. Some of the more extensive necessary changes are recorded in this paper. Several of the series have been sent for determination and are acknowledged under the species. Most of the rest were collected by Dr. and Mrs. W. L. Nutting and the author during the summers of 1948¹ and 1949.

Epicauta emarginata Champ.

Epicauta emarginata Champion, 1892, Biol. Cent.-Am., Coleop. 4 (2):426, pl. 19, fig. 24. Vaurie, 1950, American Museum Novitates No. 1477: 30.

Epicauta calcarata Werner, 1944, Psyche 50 (1943): 70; 1945, Bull. M. C. Z. 95: 477. (NEW SYNONYMY)

A long series of this species (over 150 specimens) was collected by the author 15 miles west of Lordsburg, New Mexico, Aug. 30, 1949, on flowers of a grass. Most of the specimens fit the description of *calcarata*. Some have broader and some have narrower tibial spurs than the holotype of that species. Two abnormally small individuals (7 mm.) have sparser pubescence and more slender legs and tibial spurs. The color of the pubescence varies from cinereous to dull yellow-cinereous, being cinereous in most.

Two paratypes of *emarginata* Champ., kindly loaned by Mr. J. Balfour-Browne of the British Museum, agree perfectly with some specimens in the Lordsburg series, and differ from the holotype of *calcarata* only in having slightly more slender posterior tibial spurs. The shape and size

¹This trip, for the purpose of collecting and studying Anthicidae, was made possible by a grant-in-aid from the Society of the Sigma Xi.

of the anterior and middle tibial spurs are precisely the same as in the type of *calcarata*. The two species are certainly the same.

The known range of *emarginata* is now from San Isidro² in Coahuila to west Texas and southeastern Arizona. I have the following additional records: TEXAS: Marathon, July 9, 1938 (K. U.); Culbertson Co., Aug. 30, 1947, D. J. and J. N. Knull (Ohio). NEW MEXICO: Luna Co., Oct. 1 (Ohio). ARIZONA: Douglas, Cochise Co., July 3, 1931, W. W. Jones (Parker); near Willcox, Cochise Co., Sept. 3, F. H. Parker, on flowers of *Kallstroemia* (Parker); Dragoon Mts., Cochise Co., Sept. 10, 1947, D. J. and J. N. Knull (Ohio and Werner).

Epicauta ochrea (Lec.)

Lytta ochrea LeConte, 1853, Proc. Acad. Nat. Sci. Phil. 6:342.

Epicauta ochrea, Werner, 1945, Bull. M. C. Z. 95: 495, pl. 6, fig. 42. (See for rest of synonymy)

Epicauta moniliformis Dillon, 1950, Ent. News 61: 103. (NEW SYNONYMY)

Ochrea is probably one of the more abundant species of *Epicauta* in the area from west Texas to southeastern Arizona, but is nevertheless very poorly represented in collections. The reasons it is rarely collected would seem to be twofold: first, that most collectors don't know where to look for it, and second, that most collectors who do know don't care to. Specimens can be taken at the bases of leaves of yucca or bear grass (*Nolina*) almost any time during the summer. One encounter with the leaves of either plant is usually enough. Occasional individuals are seen in the daytime on flowers of yucca. One experience with the species on yucca flowers at night convinces me that it is primarily nocturnal, though not "attracted" to light. On July 29, 1948 we camped on the west slope of the Patagonia Mts., east of Nogales, Arizona, at 5330 ft. in the oak-juniper zone. On checking a small stand of a caulescent yucca short-

² The only San Isidro I can find in Coahuila in the "Atlas Geográfico de los Estados Unidos Mexicanos", Mexico, 1943, is near the Laguna de Viesca in the southern part of the state, on the Plateau Central.

ly after dark, we found one plant in full bloom, with a swarm of *ochrea* on the blossoms, feeding on the petals and mating. We knocked down and captured several hundred specimens, losing at least twice that many in the process. They took flight readily. This night one *ochrea* came to our lighted sheet nearby, the only one I have ever seen at light.

The series taken at this time should provide a fair sample of the species. In it are small and large specimens, as is usual in almost any large sample of Meloidae. All mixed together, and with numerous cross-matings, are entirely ferruginous to very dark specimens in which the elytra are ferruginous. I have noticed this variation in color several times in the field.

Mr. Dillon has separated *moniliformis* on the basis of length of antennal scape, color, and width of body. Two eutopotypical specimens in the Chamberlain Collection are in the same size range as the two *moniliformis* types (9 and 11 mm.). The smaller specimen, a female, is colored as in Dillon's types; the larger, a male, is uniformly ferruginous. The lengths of the antennal scapes compare with the *moniliformis* description, except that in the male the scape might be just perceptibly longer.

The body form, color, and length of antennal scape can be matched in my series from the Patagonia Mts. In the same series are entirely ferruginous specimens in coitu with dark, *moniliformis*-colored specimens. There seems to be a tendency for the antennal scape to be slightly shorter in the smaller specimens. In about a third of the specimens under 12 mm. long the scape of the male antenna just reaches the hind margin of the eye; in the rest it extends beyond slightly. The measurement is a difficult one to make accurately and it often varies with the position or amount of extension of the antennae. I can see no difference in width of body in this long series or in the rest of the specimens in my collection. Apparent difference can be traced to amount of shrinkage of dried specimens, chance overlap of the elytra or amount of distension of the abdomen.

My Patagonia Mts. series shows a considerable size range, from 7 to 18 mm., with a mean length of about 14 mm.

Dark specimens are more frequent among the smaller specimens but occur also among the larger.

It is my opinion that Mr. Dillon has relied too heavily on exact measurement of variable characters in distinguishing *moniliformis*. One of the difficulties of taxonomic work with the Meloidae is the rather large amount of variation in size and correlated variation in proportions, or in expression of secondary sexual characters.

Epicauta fallax Horn

Epicauta fallax Horn, 1885, Trans. Am. Ent. Soc. 12: 111.

Werner, 1945, Bull. M. C. Z. 95: 450.

Epicauta ensiformis Werner, 1944, Psyche 50(1943): 68; 1945, *op. cit.*:462. (NEW SYNONYMY)

Dr. J. W. MacSwain has sent a series of *fallax*, from Patterson, Stanislaus Co., California, taken May 13 to June 4, 1948, by sweeping alfalfa. This series provides a much better sample of the species than was available in 1945. On rechecking the small series from Independence, California that was used in my 1945 paper I find that all of the specimens are females. The only information I had on the male was a set of notes on the type in the Horn collection. The male differs from the female mainly in the antennae, which are long and almost ensiform. The following description of the male antennae, taken from a Patterson specimen, should be added to my earlier description. Antennae $2\frac{1}{3}$ as long as an anterior tibia, reaching basal fourth of elytra. Segment I moderately slender, reaching $\frac{1}{3}$ across the eye; II small, moderately stout; III $1\frac{1}{2}$ as long as I and $\frac{1}{8}$ wider at apex, slightly curved toward the posterior; IV to VII subequal in length and breadth, about $\frac{3}{4}$ as long as III; VIII to X equal in length, about $\frac{9}{10}$ as long as VII, decreasing gradually in width so that X is about $\frac{3}{4}$ as wide as V. Proportions³ of antennal segments (to a

³ These measurements are used in an effort to provide a reasonably exact record of proportions of the individual segments. Segment I is given first. The numerators represent length, the denominators maximum width. The original measurements were made with an ocular micrometer in a stereoscopic microscope, and are accurate to ca. ± 0.02 mm. For length of a segment a measurement was taken from the construction at the base, after the condyle, to the apex. The figures obtained were converted to

total length of antenna of 1000 units): 89/38, 43/33, 124/47, 92/49, 94/54, 91/50, 91/49, 82/49, 89/48, 86/43, 118/38. Segment V is the widest and the antenna tapers gradually toward the apex, segments III to X being slightly flattened and obliquely truncated at the apex. The most characteristic feature is the presence of very short, appressed, dark hairs on the underside of segments III to XI. These are directed perpendicularly to the axis and point to the midline of the antenna from each side. They can be seen only with fair magnification and proper illumination. At low magnification the surface of the underside of the antenna appears glabrous and roughened; the upperside has moderately dense, suberect pubescence.

The presence of these appressed hairs on the underside of the male antenna distinguishes this species from all others in our fauna, except *E. ensiformis*. On re-checking the type specimens I feel that *ensiformis* is based on characters that can be extremely unsafe, the absolute length of the antennae and the width of the segments. The ratio of the lengths of antennal segments seems to provide a reasonably reliable criterion for species separation. But there is no difference in this ratio in the two. In *ensiformis* there seems to be mainly an exaggeration of the width and a very slight exaggeration of the length of the intermediate segments, to produce an ensiform antenna from the antenna of a normal *fallax* male. The types of *ensiformis* are like the *fallax* series in all other details. From experience with other species of *Epicauta* I am inclined to regard *ensiformis* as a synonym of *fallax* and fully expect that more extensive series will show a gradation between the two.

what they would be if the total antennal length, made up of the total of the individual lengths, were 10 mm. and the figures represented 0.01 mm. The total of the lengths as given is 1000 ± 3 , the error resulting from rounding off anything under 0.01 mm. It is hoped that this system of recording measurements will prove superior to a segment-by-segment comparison, where errors accumulate as one progresses. It is also hoped that the antennae of different species will be more easily compared, since all would be converted to a standard 10 mm. length. The figures must not be taken as entirely diagnostic, however. They are to be considered as representing the antennae of a single "typical" specimen.

Epicauta diversipubescens Mayd.

Epicauta diversipubescens Maydell, 1934, Trans. Am. Ent. Soc. 60: 333. Werner, 1945, Bull. M. C. Z. 95: 487.

Mr. H. B. Leech of the California Academy of Sciences has pointed out to me that the Leng Collection of Meloidae contains three specimens bearing the locality labels of Maydell's first three specimens and that each bears a red "TYPE" label, probably put on by Maydell. I find from my notes that the specimen in the U. S. N. M. which I had thought to be the holotype in 1945 was without locality label. This evidence supports Mr. Leech's contention that I saw one of the paratypes and that the holotype is now in the California Academy. This specimen seems to be a male, from Mr. Leech's description, and is further distinguished by the lack of all but the two basal segments of the left antenna and in having a hole eaten out of one side of the abdomen.

Epicauta jimenezi Dugès

Epicauta jimenezi Dugès, 1889, Anales del Museo Michoacano 2: 73. Champion, 1892, Biol. Cent.-Am., Coleop. 4 (2): 417. Vaurie, 1950, American Museum Novitates No. 1477:23.

Epicauta nigropilosa Maydell, 1934, Trans. Am. Ent. Soc. 60: 332. (NEW SYNONYMY)

Maydell seems to have been misled by Dugès' description of this insect, which was black, with the "Élitros grandes, de forma normal, granulosos y pubescentes, ferruginoso-oscuro con bonitos reflejos color de purpura." A specimen in the Instituto de Biología, Mexico, D. F., is labeled *jimenezi* E. Dugès and bears a pin label "Guadalajara". This is almost certainly one of Dugès' type specimens. Maydell's type specimen, one of a series well distributed in collections, is certainly a specimen of *jimenezi*, one of the most distinct of the genus in Mexico. The "purple" reflections on the elytra are equally well seen in the *jimenezi* type or in *nigropilosa* eutotypes, the color being produced by sparse black pubescence over rufo-testaceous background, much as the rufous pubescence over a black background produces the "purple" of *purpurea*.

The species is discussed here because certain specimens from southern Arizona appear to be assignable to it. These specimens from Arizona do not agree completely with a series from Guadalajara, differing mainly in the color of the elytra. The species is redescribed on the basis of a male specimen from Guadalajara; following the redescription a comparison is made with the Arizona specimens.

Black, the elytra rufo-testaceous, but with short black pubescence that darkens the color. Length 22 mm.; width across base of elytra 6.5 mm. Head subquadrate, as broad as long to apex of clypeus; surface densely punctured except along a narrow midline, opaque because of deep microreticulation. Antennal calluses not evident, being marked only by the slightly sparser, irregular punctures. Pubescence moderately dense but short, black, decumbent except along the lateral margins, where it is erect and longer. Eyes moderately narrow, 0.45 as broad as long, not very prominent. Antennae slender, 2.7 as long as an anterior tibia, 12 mm. long. Segment I moderately slender, reaching $\frac{2}{3}$ across the eye, almost parallel-sided; II short; III and following slender, slightly flattened, all but XI slightly wider at apex than at base. Proportions of segments (to total length of 1000 units): 108/42, 51/29, 128/33, 101/37, 93/37, 93/35, 93/33, 88/33, 79/30, 75/29, 93/27. Maxillary palpi of male slightly enlarged and flattened, glabrous beneath; labial palpi just perceptibly enlarged, also glabrous beneath.

Pronotum subquadrate, just perceptibly broader than long. Surface densely punctured, with microreticulation as on head, and with short, subdecumbent to erect pubescence. Median impressed line distinct on middle of disc; median area depressed toward base. Scutellum black. Elytra rufo-testaceous, more shallowly and sparsely punctured than the pronotum but equally opaque. Pubescence black, short, decumbent, moderately sparse but giving a darker tinge to the color of the elytra. Anterior tibial spurs slender, straight in both sexes. Male anterior tarsi with a dense flat pad, broadened particularly on the first segment, decreasing gradually in width to segment 4. The pad of segment 1 of the male is 1.9 as long as in a female of comparable size, and 1.7 as wide. In the female the pad is not as dense

or as flat as in the male and is of almost uniform width on segments 1 to 4. Posterior tibial spurs slender, sticklike, the outer shorter. Underside entirely black.

The three Arizona specimens before me are 18, 20 and 21 mm. long and are of the same proportions as the Guadalajara specimens. They differ only in having the elytra dark chocolate brown, made to appear almost black by the black pubescence. Three specimens from Champion's series are also available, through the courtesy of Mr. J. Balfour-Browne of the British Museum. Two are from Canelas and one from Ventanas, in Durango. These, and one specimen collected by myself in Tepic, Nayarit, have the elytral color intermediate between the Guadalajara and the Arizona specimens. For this reason I believe it would be preferable to postulate a North-South cline in elytral color, rather than subspecific relationship.

The species in our fauna that Arizona *jimenezi* specimens most closely resemble is *corvina* (Lec.). They differ in being opaque rather than slightly shiny and in having the elytra a bit narrower. The greater opacity is caused by the denser punctures and particularly by the deeper microreticulation. The middle and hind tibiae of *jimenezi* males are almost straight, as in the female, while in *corvina* males they are slightly flattened, broader and more bowed than in the female. The anterior tarsal pads of the male of *corvina* are denser, broader and flatter than in the female but the pad on segment 1 is shorter than in the male of *jimenezi*, being only about 1.5 as long as in the female of its own species. The two species are otherwise so similar that they must be very closely related. Arizona specimens will key to *corvina* in my 1945 key but can be distinguished by the characters given above.

Type locality: Guadalajara, Jalisco, MEXICO. (of *nigropilosa* Mayd.: same locality, Aug. 17, 1903, McClendon).

Additional records: MEXICO: 1, Tepic, Nayarit, July 22, 1952, F. W. & F. G. Werner, on flowers of a Composite (FW); Ventanas, Durango, Forrer; and Canelas, Durango, Becker (BMNH). ARIZONA: 1 male, Patagonia, July 4, 1929, F. W. Nunenmacher Coll. (CNHM); 1 female, W. slope of Patagonia Mts. on Lochiel Road, St. Cruz Co., 5330 ft. in oak-juniper zone, July 28, 1948, W.

L. Nutting & F. G. Werner (FW); 1 female, Tumacacori Mts., July 22, 1940, D. J. & J. N. Knull (Parker).

Epicauta languida (Horn)

Macrobasis languida Horn, 1895, Proc. Calif. Acad. Sci. (2) 5: 252.

Epicauta languida, Werner, 1945, Bull. M. C. Z. 95: 424, 501.

The California Academy of Sciences has a small series of this species, as well as the holotype. Below is a short redescription, based on notes taken on the holotype (No. 154), seen in 1946, and checked at that time with the more recent specimens. The species should be left in my group A, in which the male does not have a row of stout apical teeth on the metatibia, and should be placed near *excors* and *tenuilineata*.

Color luteous, with the antennae brown. Pubescence tannish cinereous, depressed. Elytra with humeral and scutellar dark markings. Head narrowly ovate, the surface densely punctured, with the intervals punctulate. Median impressed line fine, distinct down to the level of the hind margin of the eyes. Antennal calluses denuded, smooth, of moderate size and only slightly raised. Eyes transverse, moderately narrow, emarginate. Male antennae $3 \frac{1}{2}$ as long as an anterior tibia. Segment I flat, straight, reaching almost to occiput; II almost as long as I, flattened, slightly curved; III short, $\frac{1}{3}$ as long as II, $\frac{2}{3}$ as long as IV; IV the largest of the succeeding segments, rest just slightly shorter, slender, slightly flattened. Female antennae with segment I reaching hind margin of the eye; II almost as long as I; III approximately $\frac{1}{2}$ as long as II; IV and following equal, almost as long as II. Pronotum campanuliform, $\frac{1}{4}$ longer than broad; median impressed line distinct from $\frac{1}{4}$ from base to $\frac{1}{3}$ from apex; a prominent impression at middle of base. Anterior tibiae of male with two spurs, the inner slightly the shorter; male anterior tarsi not modified. Posterior tibial spurs spiniform, only very slightly broadened. Underside not marked. Legs marked as in *polingi* Werner.

Distribution: BAJA CALIFORNIA: Beside the holotype from San José del Cabo there are specimens in the California

Academy of Sciences collected by Michelbacher and Ross. from 10 mi. N.W. of LaPaz, Oct. 6, 1941; Arroyo Seco, Oct. 6; San Venancio, Oct. 8; and Agua Caliente, Cape Region, Oct. 18. It is thus far known only from the southern part of the peninsula.

NEW ENGLAND RECORDS OF *ULULODES* CURRIE (NEUROPTERA: ASCALAPHIDAE). — There are few records of the two indigenous species of *Ululodes* from the northeastern corner of the United States. The genus is not mentioned in Procter's Biological Survey of the Mount Desert Region [Maine], Part VII, 1946, nor is it recorded by Johnson in his Insects of Nantucket, 1930, or by Britton in the Check-List of the Insects of Connecticut, 1920 and 1938. There is only one citation in Leonard's List of the Insects of New York, 1926; and this is of *U. quadripunctata* from Staten Island, in the extreme southeast. Records of both species are more plentiful in Smith's Insects of New Jersey, 1910, and Brimley's Insects of North Carolina, 1938; the former work citing two localities for *U. hyalina* and five for *U. quadripunctata*, and the latter, four and two localities for these species, respectively.

Inasmuch as they represent extensions of the known ranges of both species, the following records from the author's collections are presented herewith, even though lacking such desirable data as precise locality and year of collection: *Ululodes hyalina* Latr., Marthas Vineyard, Massachusetts, 19 July, 1 specimen at light. *Ululodes quadripunctata* Burm., Marthas Vineyard, Mass., 2 August, 1 specimen at light; New London, Connecticut, July-August, 1948, 1 specimen. In all cases, poor condition precludes determination of sex of these specimens. The author will gratefully receive any records or specimens of *Ululodes* from the northeastern United States. — George H. Beatty, III, Plumsteadville, Pennsylvania.

A NEW NEOTROPICAL *CHRYSOPS*
(DIPTERA, TABANIDAE)¹

BY L. L. PECHUMAN
Lockport, New York

The writer has realized for some time that the *Chrysops uruguayensis* discussed by Kröber (1926) was not the species described by Lutz under that name. However, he did not wish to add to the already overburdened synonymy of Neotropical *Chrysops* and as long as the identity of two of Brethes' species was unknown, there was danger of this. Dr. Walter H. Hack of the Instituto de Medicina Regional, Resistencia, Argentina, has kindly furnished the writer with descriptions of the Brethes species and both of them seem to be distinct from the species described below.

Chrysops patricia n. sp.

Holotype female. Length 8 mm.

Head: First two antennal segments yellow-brown with black hairs; third antennal segment yellow-brown at base, flagellum black; third antennal segment subequal in length to total length of the first two segments. Frons yellow-gray pollinose with pale hairs; dark brown pollinose in ocellar area with dark hair. Frontal callus large, brown, margined above with black. Frontoclypeus shining dark yellow with a narrow yellow-gray pollinose stripe extending from beneath the antennae about half the length of the frontoclypeus. Cheeks densely grayish-yellow pollinose with a denuded area below on each side which is mottled yellow and black. Palpi yellow-brown, paler on inner surfaces. Proboscis black. *Thorax*: Dorsum dark brown with two narrow pale stripes and a broader stripe on each side above the wing base. Scutellum reddish brown with a faint dark horizontal stripe near base. Pleura brown with the usual yellowish pollinose areas. Halteres brown. Legs slender, mostly dark brown with a reddish tinge which is especially evident on the fore coxae and middle tibiae; middle and

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hind tarsi reddish brown, becoming darker at apex. Wings as figured; membrane very clear; the outer margin of the crossband is straight to the third longitudinal vein where it cuts back toward the base of the wing and then again runs straight to the fourth posterior cell where it stops short of the wing margin; the fourth posterior cell is slightly more than half infuscated; the fifth posterior cell is mostly hyaline with a small infuscated area at the base; the inner margin of the crossband reaches the posterior margin of the wing only as a narrow streak along both sides of the vein separating the fifth posterior and anal cells; apical spot narrow, the same width as the marginal cell, extending into the upper corner of the second submarginal cell over about one-fifth of the upper branch of the third

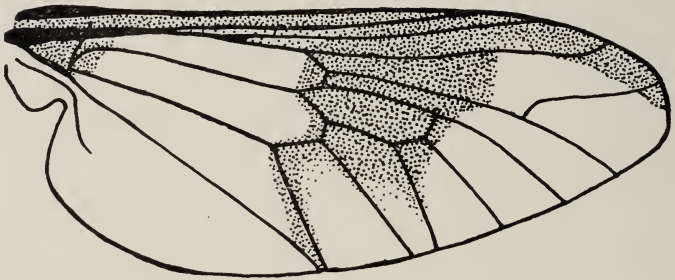


Fig. 1. *Chrysops patricia* Pechuman n. sp. Wing.

longitudinal vein. *Abdomen*: Abdomen dark brown with pale grayish yellow markings. First tergite dark brown with a pale posterior border which expands laterally reaching the anterior margin of the segment and leaving an isolated dark brown spot on the posterior margin at the lateral margin of the segment; second tergite with large pale lateral spots which are the full width of the tergite at the lateral margins and gradually narrow toward the center and do not quite meet along the anterior margin of the tergite, and with a pale posterior border which expands into a large mid-dorsal triangle which reaches the anterior margin, and on each side of the mid-dorsal triangle the pale border expands to form a small flat triangle; third to sixth tergites dark brown with pale posterior borders which on the third and fourth tergites expand into small mid-dorsal

triangles. First sternite dull yellow with some vague dark markings; second sternite dull yellow with a faint indication of a dark central spot; third sternite dull yellow with a large median spot; fourth and following sternites fuscous with a yellow posterior border.

Cerro Pelado, Paraguay (F. Schade), M. C. Z. No. 29080. *Paratypes*: 1 female with same data as holotype; 1 female, Villarrica, Paraguay (F. Schade); 1 female, Aregua, Paraguay, 20 September 1915 (Zurcher); 1 female, Tucumán, Argentina, October; 1 female, Gran Guardia, Territory of Formosa, Argentina, October, 1952 (J. Foerster). Another female from Villarrica was studied, but since it is in poor condition and differs in several particulars from the rest of the material, it is not included in the paratype series.

Holotype and two paratypes No. 29080, in the Museum of Comparative Zoology, Cambridge, Massachusetts; three paratypes in the collection of the writer.

Variations: The series of specimens varies in length from 7 to 9 mm. The pollinose stripe on the frontoclypeus varies from a little longer to a little shorter than in the holotype. Some of the specimens show some indefinite dark streaks on the frontoclypeus and slight darkening around the frontoclypeal pits. The denuded area on the lower portion of the cheeks varies in size, and in color, from yellow to black. In two specimens the two pale stripes on the dorsum of the thorax broaden anteriorly until they meet. In one specimen the dark marking of the second tergite is reduced so that the pale lateral triangles reach across the dark marking leaving two dark spots near the posterior-lateral margins of the tergite. In one specimen the pale median triangle of the second tergite does not reach entirely across the segment although its upper portion is indicated by a paling of the dark marking in that area.

Comparative Notes: *C. patricia* seems to be the species discussed by Kröber (Konowia 4: p. 358, 1926) as *uruguayensis*. Kröber, however, mentioned that his interpretation of *uruguayensis* differed from Lutz' description of the wing pattern of the type. In some undetermined material at the United States National Museum, made available through the kindness of Dr. Alan Stone, the writer several years ago found a specimen from Buenos Aires, Argentina, which

closely matches Lutz' description and figure of *uruguayensis*. Three other specimens recently received also match Lutz' species. These were collected by Juan Foerster on February 15, 1953 at Isla Berna in the delta of the Paraná River near Tigre, Province of Buenos Aires, Argentina. *C. patricia* is easily separated from *uruguayensis* Lutz by the hyaline apical portion of the fourth posterior cell, uniformly narrow apical spot united for almost its full width with the crossband (apical spot expanded apically and just barely united with the crossband in *uruguayensis*) and by the outer margin of the crossband which is relatively straight below the third longitudinal vein and somewhat irregular in *uruguayensis*.

Kröber thought what he considered to be *uruguayensis* might be the same as *bonariensis* Brethes but on a basis of Hack's recent paper (1951) they must be quite different. The species redescribed by Hack, who had access to Brethes' type, is either the same or closely related to *C. trifaria* Macquart.

Some of the specimens of *C. patricia* received from the Museum of Comparative Zoology, through the cooperation of Dr. J. C. Bequaert, were labeled *paraguayensis* Brethes. Dr. Hack kindly sent a redescription of the type of *C. paraguayensis* to the writer and this indicates that this species lacks an apical spot and the crossband is straight from the costa to the posterior margin of the wing. *C. paraguayensis* evidently is closely related to *C. formosa* Kröber and may be the same although the known range of the two forms is rather widely separated.

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THREE NEW SPECIES OF PANORPIDAE
(MECOPTERA)

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The new species of Mecoptera described below have come to my attention during a study of Old World Panorpidae.

Genus *Panorpa*

***Panorpa chiensis*, n. sp.**

(Pl. 5, figs. 1-3; text-fig. 1,A)

Body mostly black; vertex and rostrum uniformly shining black; thorax black dorsally, reddish brown laterally; the 1st-9th abdominal segments of male shining black dorsally and ventrally; the hind process of the third tergite is short and stout, unusually broad, with more or less truncate apex, and is in contact with the very short conical median projection of the fourth tergite; the 6th-8th segments not prolonged. Fore wing: length, 17.2-19 mm.; width, 4.7-5.2 mm.; membrane hyaline, markings brownish black; pterostigma not very prominent. Hind wing: length 15.5-17 mm.; width, 4.5-5.1 mm. ♂ genitalia: genital bulb slender; coxopodites long, their inner margins bearing a rounded process distally and a sharp tooth-like process medianly; harpagones slender, the outer margin greatly concave near the base, inner margin with a triangular process and a true basal lobe, which bears a tuft of bristles; the apex of harpagones usually truncate; hypandrium broad basally; branches of hypoalvae broad distally, its distal outer margins fold upward to form a triangular plate on the edge, the apex folded upward to form a rounded distal end, which reaches to the base of the harpagones; parameres simple, each consisting of a simple stalk, which broadens distally with a somewhat twisted apical portion, its distal inner margin usually bearing a row of short barbs; preëpiproct narrow towards apex, with very small U-shaped distal incision; aedeagus with prominent finger-like ventral processes, apical processes finger-shaped, lateral processes very short, sharp tooth-like, extended upward.

♀ unknown.

Holotype (♂): Chi-i, Korea; July 5, 1940; in the Museum of the Institute of Zoology, Academia Sinica, Shanghai.

Paratypes: Same collecting data as holotype: 1 ♂, in the above Institute of Zoology; 1 ♂, in the Museum of Comparative Zoology; 1 ♂, in Cheng Collection.

At first sight this species looks like *Panorpa approximata* Esben-Peterson, but the peculiar shape of the genitalia in the male easily separates the two species.

Genus *Neopanorpa*

***Neopanorpa baviensis*, n. sp.**

(Pl. 5, figs. 6-8; text-fig. 1,B)

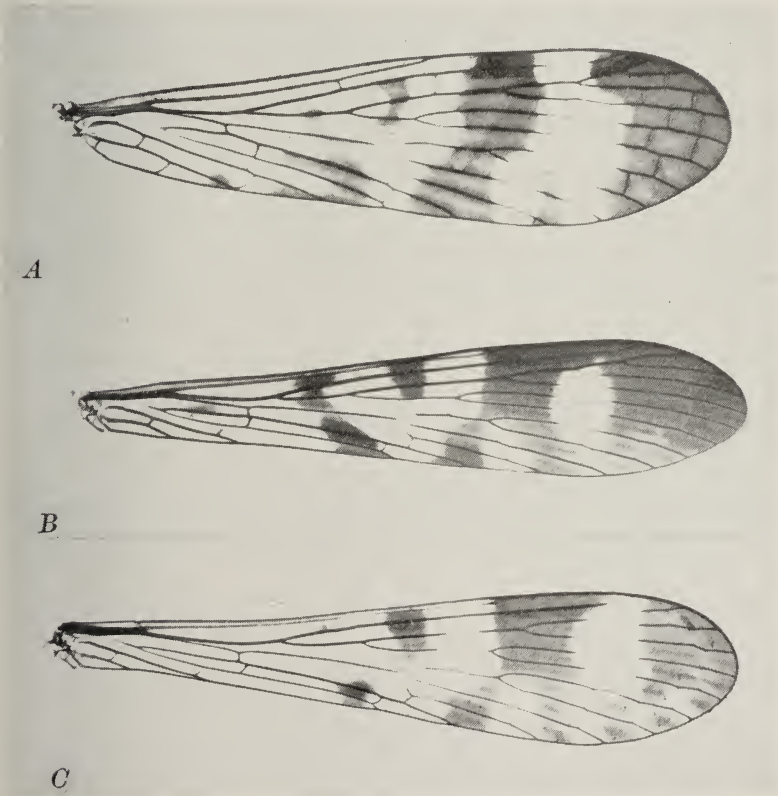
Body grayish brown, vertex grayish brown posteriorly, black anteriorly; rostrum brown, with grayish brown longitudinal stripe on each side; thorax brown, meso- and metanotum with grayish brown median streak; the 1st-9th abdominal segments of male grayish brown dorsally and ventrally, median process of 3rd tergite short, extending a little beyond the middle of the 4th tergite. Fore wing: length, 15.5 mm.; width, 3.2 mm., membrane slightly brown, markings blackish brown; pterostigmal band broad, complete, with broad basal branch and apical branch; basal band complete; apical band very large, connected with the pterostigmal band at both the front and hind margins; basal spot obscure; marginal spot present; pterostigma not very prominent. Hind wing: length, 15 mm.; width, 3.1 mm., similar to fore wings, except that the basal band is indicated only by a spot at the hind margin. ♂ genitalia: genital bulb slender; coxopodites long with truncated apex; harpagones slender, the outer margin slightly concave at the middle, with a row of short black hairs at the middle; inner margin with a slightly projecting median portion and a small basal lobe which bears a small tooth-like process on its dorsal edge; hypandrium long; branches of hypovalvae slender, the basal portions wide apart, the distal portions, slightly overlapping each other; the apex of hypovalvae usually reaching to the middle of the harpagones; parameres simple, small and curved; preepiproct slightly enlarged distally and with truncated apex; aedeagus small, with a pair of tooth-like processes on its dorsal edge, the

apical processes united, lateral processes tooth-like, usually bent upwards.

♀ unknown.

Holotype (♂): Mt. Bavi 800-1000 m., Tonkin; July, 1941; A. DeCooman; in Heude Museum, Shanghai.

Paratype: 1 ♂; same collecting data as holotype, in Cheng Collection.



Text-fig. 1. A. *Panorpa chiensis*, n. sp., fore wing. B. *Neopanorpa baviensis*, n. sp., fore wing. C. *Neopanorpa contracta*, n. sp., fore wing.

This species differs from other described *Neopanorpa* by its rather sharp wing apex and the very long branches of the hypoalvae in the male.

Neopanorpa contracta, n. sp.
(Pl. 5, figs. 4-5; text-fig. 1,C)

Body mostly brown; vertex sooty brown, rostrum uniformly grayish brown; thorax deep brown dorsally; the 1st-7th abdominal segments of female deep brown dorsally, last few abdominal segments light brown. Fore wing: length, 14.5 mm.; width, 3.2 mm.; membrane hyaline, markings grayish brown; pterostigmal band complete, with a broad basal branch and apical branch; basal band represented by a spot; apical band large with two hyaline spots; basal spot absent; marginal spot large; pterostigma not very prominent; the basal portion of wing is very long and narrow. Hind wing: length, 13.2 mm.; width, 3 mm.; similar to the fore wing. ♀ genitalia: subgenital plate broad with wide v-shaped distal incision; internal skeleton small, the posterior arms of the plate rather long, twisted, with narrow apex, the axis shorter than the posterior arms, extending a little beyond the plate.

♂ unknown.

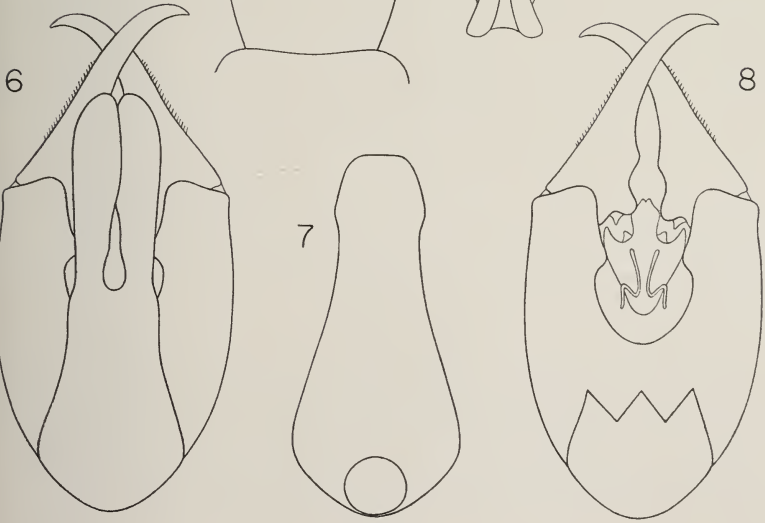
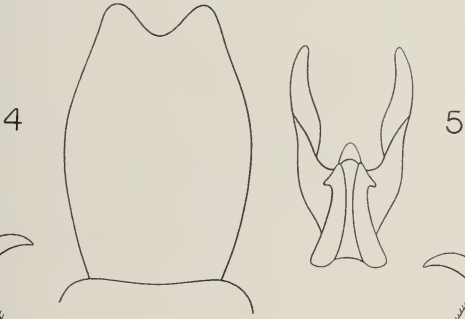
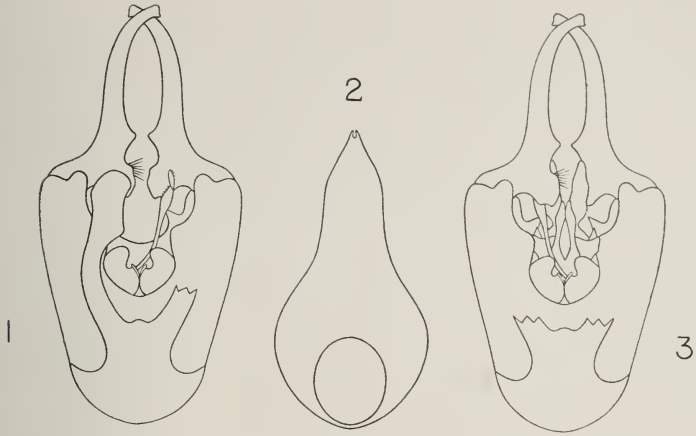
Holotype (♀): Darjeeling, India; May, 1938; Maa; in Maa Collection.

Paratype: 1 ♀; same collecting data as holotype; in Cheng Collection.

This species is easily distinguished from others of the genus by the very long and contracted basal portion of the wings. The shape of the female genitalia also makes its recognition easy.

EXPLANATION TO PLATE 5

Figs. 1-3. *Panorpa chiensis*, n. sp. 1, ventral view of genital bulb of ♂; 2, præpiproct of ♂; 3, ventral view of genital bulb of ♂ with harpagones removed. Figs. 4-5. *Neopanorpa contracta*, n. sp. 4, subgenital plate of ♀; 5, internal skeleton of ♀. Figs. 6-8. *Neopanorpa baviensis*, n. sp. 6, ventral view of genital bulb of ♂; 7, præpiproct of ♂; 8, genital bulb of ♂ with harpagones removed.



CHENG — NEW PANORPIDAE

LARVAL MITES OF THE GENUS *EUTROMBIDIUM*
ATTACHED TO A CAROLINA LOCUST

BY W. W. JUDD

Department of Zoology
University of Western Ontario, London

A pinned female specimen of the Carolina Locust (*Dissosteira carolina* L.) captured at Bayfield, Ontario, July 25, 1924, and deposited in the collection of the University of Western Ontario, had a number of mites attached to the upper surface of the hind wings (Fig. 1 - L). Some of the mites were scraped off with a needle and were put in preservative and were identified by Dr. E. W. Baker, Bureau of Entomology and Plant Quarantine, Washington, D. C., as *Eutrombidium (trigonum)* (Hermann) ?.

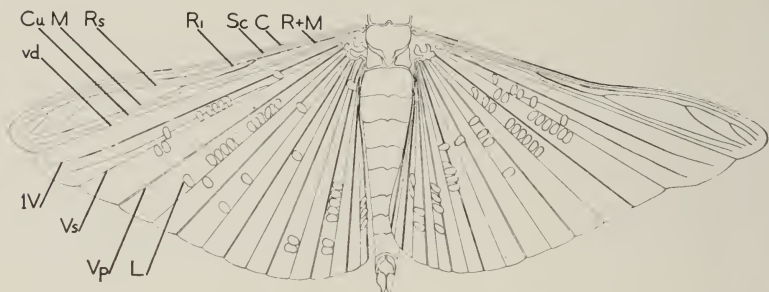


Fig. 1. Outspread hind wings of *Dissosteira carolina* L. to show attached larval mites (L). C—Costa, Cu—Cubitus, M—Media, Ri—First branch of Radius, Rs—Radial sector, R+M—Radius+Media, Sc—Subcosta, IV—First Vannal vein, vd—vena dividens, Vp—primary vannal vein, Vs—secondary vannal vein.

There were 39 mites on the left wing and 40 on the right wing, on the upper surface, and a single mite was located on the lower surface of the left wing on a vannal vein near the hind border of the wing. They were attached to the veins by their anterior ends and were confined to the sec-

ondary veins of the vannal region (Fig. 1 - Vs). Snodgrass¹ shows that when the wings of the locust are folded the secondary vannal veins lie in troughs of the folds. Severin² says of the attachment of the mites that "on the adult grasshoppers, the favorite location is in the folds or plications of the hind wings." He records that on an adult female of *Dissosteira carolina* 175 mites were found attached to the body and appendages. On the specimen from Bayfield the mites were attached only to the hind wings. Some of the mites were softened in alcohol and when examined under the microscope proved to be six-legged larvae which resembled the figures of "active engorged" larvae shown by Severin (1944).

¹ 1935. Principles of insect morphology. McGraw-Hill Book Co., New York.

² 1944. The grasshopper mite, *Eutrombidium trigonum* (Hermann), an important enemy of grasshoppers. South Dakota State College Agr. Exp. Sta. Bull. 3.

A GREGARINE, *DIPLOCYSTIS*, IN THE
HAEMOCOELE OF THE ROACH,
BLABERUS CRANIIFER BURM.

BY W. L. NUTTING

Biological Laboratories, Harvard University

Until such time as the genus of giant cockroaches, *Blaberus*, is better known, both taxonomically and biologically, it would be useless as well as impossible to present even a reliable list of their internal parasites. Furthermore, considering our meager knowledge of the protozoan faunas of some of our commonest roaches, the mere identification of forms in exotic roaches such as these, must often involve a certain amount of original research. However, since *B. craniifer* has gained considerable standing as a general laboratory animal in many institutions, attention should be called to a rather unusual acephaline gregarine, probably a *Diplocystis*, which has been noted in some cultures of this insect. Gregarines seem not to have caught and held the attentions of many protozoologists, but the encountering of such large, immobile bodies as *Diplocystis* during dissection of a cockroach, seldom fails to arouse the curiosity of the entomology student.

The stages of this gregarine most commonly seen are the paired trophozoites, and the cysts following the complete fusion of these pairs (fig. 1). Both stages are opaque white and smooth, and frequently attain a length or maximum diameter approaching 2 mm. Staining with haematoxylin reveals the nuclei and a coarsely granular cytoplasm in these otherwise almost characterless organisms. From one to 12 or more paired trophozoites or cysts may be found in the haemocoel among lobes of the fat body, generally near coils of the hind gut, but occasionally in the thorax. The early stages of *Diplocystis schneideri* Kunstler are found in the mid gut epithelium of *Periplaneta americana* until sufficiently developed to enter the host's body cavity. The cannibalistic tendencies of roaches insure the parasite's

perpetuation through the ingestion of mature spore-containing cysts along with the tissues of weakened or dead infected individuals. This mode of infection probably explains why heavy infections in this gregarine are rare, even in crowded cultures of roaches, for crowding favors the growth of enormous infections of many gregarines whose cysts are passed with the feces.



Fig. 1. Paired trophozoites (left) and early cyst of *Diplocystis* sp. from the haemocoel of *Blaberus craniifer*, X 13.

Since the mid gut and hind gut of *B. craniifer* harbor at least two cephaline gregarines, along with a number of other protozoans and nematodes, it is impossible at present to assess the effect of any one of them on the health of the roach. The presence of *D. schneideri* in *Periplaneta* raises doubts as to the specific identity of the *Diplocystis* in laboratory cultures of *Blaberus*. Large numbers of *Periplaneta*, raised adjacent to *Blaberus* cages, have been examined for the parasite with negative results. However, the identification of the *Diplocystis* in *Blaberus*, either as *schneideri* or as some other species, might involve carefully controlled and lengthy infection experiments. Although the life cycle of many gregarines is known, detailed information on their biology and host specificity is extremely limited.

It might be added that the gregarines most often observed by entomologists belong to the tribe Cephalina. These are commonly found in the alimentary canal of arthropods and other invertebrates. Some may accidentally reach the haemocoel, but only a few are regularly found there. On the other hand, members of the Acephalina are confined chiefly to the haemocoel and associated organs. Most of the known acephalines are found in annelids, but a few are known from echinoderms and insects. I wish to thank Dr. Victor Sprague of Black Mountain College, Black Mountain, N. C., for examining the gregarine fauna of *Blaberus*,

and suggesting that this particular one might well be a *Diplocystis*. For a partial synopsis of this genus, reference should be made to the following paper which also contains a list of pertinent literature. (Semans, F. M. 1943. Protozoan parasites of the Orthoptera, with special reference to those of Ohio. Part IV: Ohio Jour. Sci., 43: 221-234, 271- 276.)

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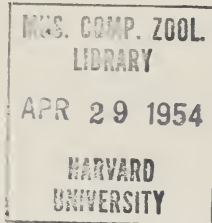


TABLE OF CONTENTS

| | |
|---|-----|
| The Ant Larvae of the Myrmicine Tribe Pheidologetini. <i>G. C. Wheeler</i> and <i>J. Wheeler</i> | 129 |
| Some New Synonyms in Clytrinae (Coleoptera, Chrysomelidae). <i>F. Monrós</i> | 148 |
| Two New Tingidae (Hemiptera). <i>C. J. Drake</i> | 151 |
| Additional Notes on <i>Brachypanorpa</i> . <i>F. M. Carpenter</i> | 154 |
| Cicindelidae (Tiger Beetles) Collected in Eastern New Guinea, with Description of a New Species. <i>C. M. C. B. van Nidek</i> | 155 |
| The Indo-Australian Species of the Ant Genus <i>Strumigenys</i> Fr. Smith: Group of <i>doriae</i> Emery. <i>W. L. Brown, Jr.</i> | 160 |
| Index to Volume 60 | 167 |

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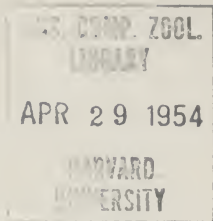
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THE ANT LARVAE OF THE MYRMICINE TRIBE PHEIDOLOGETINI¹

BY GEORGE C. WHEELER and JEANETTE WHEELER

Department of Biology, University of North Dakota

In the *Genera Insectorum* Emery included the genera *Lophomyrmex*, *Trigonogaster*, *Pheidologeton*, *Aneleus*, *Oligomyrmex*, *Erebomyrma*, *Carebara* and *Paedalgus* in the tribe Pheidologetini. Wheeler placed these genera in the Solenopsidini but admitted (1922, p. 659) that the latter tribe was "very unsatisfactorily defined." We have followed Emery.

The tribe Pheidologetini comprises about a hundred species, most of which are Paleotropical. The tribe is noted for the large size of the queens. In *C. vidua*, for example, the volume ratio of queen to worker is several thousand to one. *Pheidologeton* is a genus of harvesters, with a polymorphic worker caste ranging from minute minimaes through a graded series to gigantic soldiers with enormous heads. The other genera are suspected of having relations with termites, though just what sort of relations has never been proved. At least they nest in termitaria. *Aneleus* and *Oligomyrmex* have the worker caste strongly dimorphic — large headed soldier and small worker. In *Lophomyrmex*, *Trigonogaster*, *Erebomyrma*, *Carebara* and *Paedalgus* the worker caste is monomorphic and minute.

In this article we have described the larvae of 13 species in seven genera. These larvae do not constitute a homogeneous group. They are nevertheless better defined

¹The research on which this article is based was aided by a grant-in-aid from the Sigma Xi — Resa Research Fund.

as a group than are the larvae of the Solenopsidini (either in the sense of Emery or in the sense of Wheeler) to the extent that at least a few minor characters are common to all the known genera. The subtribes, however, are homogeneous and easily differentiated. Within each subtribe the genera are not easily distinguished.

Tribe PHEIDOLOGETINI Emery

Body hairs moderately numerous and uniformly distributed. Anchor-tipped hairs absent. Antennae small. Head hairs few. Labrum short and broad (breadth $2\times$ to $3\times$ length). Ratio of head width to mandible length = 3.0 to 4.0; average 3.5. Ratio of mandible length to mandible width (at base) = 1.4 to 2.4; average 1.7. Surface of maxillae without spinules. Anterior surface of labium spinulose.

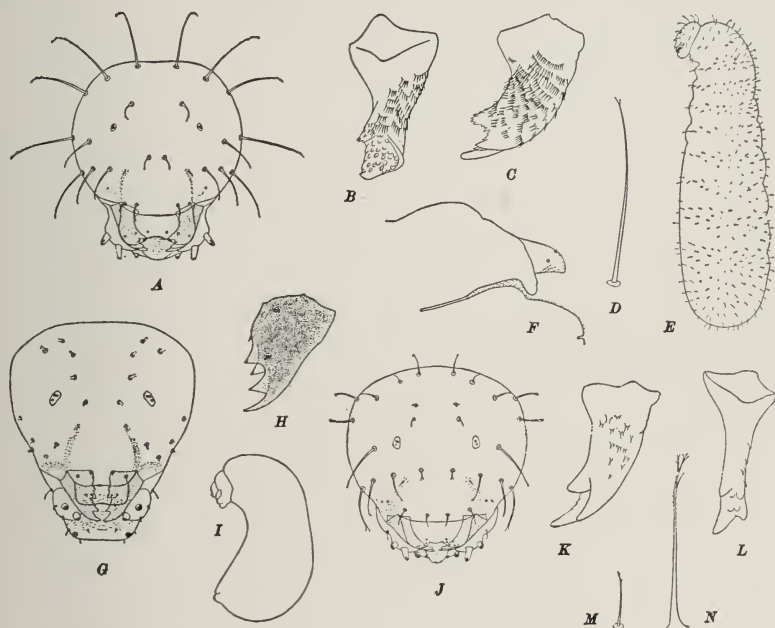
Subtribe LOPHOMYRMICINI Emery

Body hairs all of the same shape: either with the tip denticulate or with the tip bifid. Labrum trilobed, the median lobe projecting posteriorly. Posterior surface of labrum densely spinulose. Mandibles as a whole curved medially; teeth surrounding a denticulate area; anterior surface spinulose. Labium with a median anteroventral projection, which bears the opening of the sericteries at its apex. Labial palp a low knob bearing five sensilla. Hypopharynx spinulose.

Genus *Lophomyrmex* Emery

Thorax rather stout and bent ventrally at right angles; abdomen elongate-ovoidal; diameter greatest at the fourth and fifth abdominal somites; posterior end broadly rounded. Body hairs moderately numerous and short; all with the tip denticulate. Antennae small. Head hairs few, short to moderately long, with the tip denticulate. Labrum small, trilobed, with the median lobe projecting posteriorly; posterior surface densely spinulose. Mandibles slender and thin; curved medially; apical tooth curved medially and posteriorly; a large anterior subapical tooth directed anteroventrally; a large blunt medial tooth directed posteroventrally; teeth surrounding a denticulate area; anterior surface with several sharp spinules. Maxillary palp a peg

bearing five sensilla. Labium with a median anteroventral spinulose projection, with the opening of the sericteries at its apex. Labial palp a low knob bearing five sensilla. Hypopharynx with a few oblique rows of minute spinules.



Text figure 1. *Trigonogaster recurvispinosa kemneri* Wheeler, A-F —A, head in anterior view, $\times 85$; B, left mandible in medial view, $\times 247$; C, left mandible in anterior view, $\times 247$; D, body hair, $\times 329$; E, larva in side view, $\times 18$; F, left half of labrum and labium in sagittal view, $\times 165$.

Erebomyrma sp., G-I —G, head in anterior view (with hair bases only), $\times 108$; H, left mandible in anterior view, $\times 247$; I, profile, $\times 18$.

Lophomyrma quadrispinosus (Jerdon), J-N —J, head in anterior view, $\times 85$; K, left mandible in anterior view, $\times 192$; L, left mandible in medial view, $\times 192$; M and N, two body hairs, $\times 209$.

Lophomyrma quadrispinosus (Jerdon)

(Text. fig. 1, J-N)

Thorax rather stout and bent ventrally at right angles; abdomen elongate-ovoidal; diameter greatest at the fourth

and fifth abdominal somites; posterior end broadly rounded, anterior end formed from the dorsum of the prothorax. Anus posteroventral. Leg vestiges present. Segmentation indistinct. Integument of ventral surface of thorax and abdominal somites I-III with numerous transverse rows of spinules. Body hairs moderately numerous, short (0.036-0.126 mm), all with denticulate tip; hairs without alveolus and articular membrane except on the prothorax. Head moderately large; cranium transversely subelliptical, breadth $1.25 \times$ length. Antennae small, each with three (rarely two) sensilla, each of which bears a spinule. Head hairs few, short to moderately long (0.018-0.072 mm), with denticulate tip. Labrum small, short (width $2 \times$ length), trilobed, the median lobe projecting posteriorly; anterior surface of each lateral lobe with three minute hairs and/or sensilla; ventral border of each lateral lobe with three sensilla and several short oblique rows of exceedingly minute spinules; posterior surface of each half with 1-2 isolated and a cluster of 3-4 sensilla; posterior surface spinulose, the spinules minute and in numerous long transverse rows. Mandibles slender and thin; curved medially; apical tooth curved medially and posteriorly; a large anterior subapical tooth directed anteroventrally; a large blunt medial tooth directed posteroventrally; teeth surrounding a denticulate area; anterior surface with several sharp spinules. Maxillae with the apex paraboloidal; palp a peg with one subapical (bearing a spinule) and four apical sensilla; galea a rather tall peg with two apical sensilla. Labium with a median anteroventral projection covered with short rows of minute spinules; palp a low knob with five sensilla (one of which bears a spinule); a minute sensillum between each palp and the opening of the sericteries; the latter a transverse slit on the end of the projection. Hypopharynx with a few oblique rows of minute spinules.

SEXUAL LARVA: Elongate-ovoidal; head small, on the ventral surface near the anterior end. Body naked. Head naked but with minute sensilla. Mandibles with all teeth directed medially. Otherwise similar to worker larva.

Material studied: numerous slightly damaged larvae from Java labelled "var. *opaciceps* Viehmeyer."

Genus TRIGONOGASTER Forel

Long, slender, club-shaped, with only the prothorax bent ventrally to form a very short neck; posterior end broadly round. Body hairs moderately numerous, very short, usually with a short-bifid tip. Antennae minute. Head hairs few, long and with some part of the distal half finely denticulate. Labrum trilobed, with the median lobe projecting posteriorly; posterior surface densely spinulose. Mandibles curved medially; apical tooth round-pointed and curved medially; a large anterior subapical tooth directed anteroventrally; a large blunt medial tooth directed posteroventrally and sometimes covered with spinules; teeth surrounding a denticulate area; anterior surface with many long slender spinules arranged in transverse arcuate rows. Maxillary palp a peg bearing five sensilla. Labium with a median anteroventral spinulose projection, with the opening of the sericteries at its apex; labial palp a low knob bearing five sensilla. Hypopharynx with numerous transverse rows of minute spinules.

Trigonogaster recurvispinosa kemneri Wheeler

(Text fig. 1, A-F)

Long, slender, club-shaped, with only the prothorax bent ventrally to form a very short neck; posterior end broadly rounded. Anus posteroventral. Spiracles small, the mesothoracic larger than the others. Integument with minute spinules on the ventral surface of the thorax. Body hairs moderately numerous, uniformly distributed, very short (0.018-0.108 mm), usually with very short-bifid tip; with alveolus and articular membrane. Head moderately large; cranium transversely subelliptical, slightly broader than long. Antennae minute, each with three sensilla, each of which bears a spinule. Head hairs few, long (0.04-0.105 mm) and with some part of the distal half finely denticulate. Labrum short (breadth $2\times$ length), trilobed, the median lobe projecting posteriorly; anterior surface of each lateral lobe with 2-3 minute hairs and/or sensilla; ventral border of each lateral lobe spinulose and with one isolated and two contiguous sensilla; posterior surface of each half with 3-4 isolated and two contiguous sensilla; posterior surface densely spinulose, the spinules minute and in numerous

long transverse rows. Mandibles curved medially; apical tooth round-pointed and curved medially; a large anterior subapical tooth directed anteroventrally; a large blunt medial tooth directed posteroventrally and sometimes covered with spinules; teeth surrounding a denticulate area; anterior surface with many long slender spinules arranged in transverse arcuate rows. Maxillae with the apex paraboloidal; palp a peg with one subapical (bearing a spinule) and four apical (two bearing each a short spinule) sensilla; galea a tall slender frustum with two apical sensilla. Labium with a median anteroventral projection covered with short rows of minute spinules; palp a low knob with five sensilla (three bearing a spinule each); opening of sericteries a short transverse slit on the end of the projection. Hypopharynx with numerous transverse rows of minute spinules. (Material studied: eight larvae from Java.)

Subtribe PHEIDOLOGETINI Emery

Body hairs of two or three types; those on the dorsal and lateral surfaces deeply bifid, with the branches curling away from each other. Labrum subrectangular, with the ventral corners rounded. Posterior surface of labrum sparsely spinulose or without spinules. Mandibles as a whole not curved medially; the teeth not surrounding a denticulate area; anterior surface without spinules. Labium without a median projection. Labial palp represented by a cluster of four sensilla. Hypopharynx apparently without spinules.

Genus *Pheidologeton* Mayr

Short and stout; prothorax forming a stout neck, which is bent ventrally to a right angle; dorsal profile C-shaped, ventral profile of abdomen nearly straight; diameter greatest at abdominal somites III and IV. Body hairs moderately numerous and short. Of three types (with intergrades): (1) deeply bifid, with the branches curling away from each other and enlarged at the tip, the most abundant type (but absent from the ventral surface); (2) bifid, with the branches acuminate and nearly straight, a few on the ventrolateral surfaces; (3) a few simple hairs on the ventral

surface. Antennae small. Head hairs few, short, simple or with denticulate tip. Labrum subrectangular; posterior surface sparsely spinulose. Mandibles small, short, stout and thick; apex forming a small tooth which is curved medially and posteriorly; with two small medial teeth near the anterior surface. Maxillary palp a low elevation bearing four sensilla; galea a low knob. Labial palp represented by a cluster of four sensilla. *Sexual (?) larva* voluminous, plump, turgid, bean-shaped; head exceedingly minute, on the ventral surface near the anterior end; mandibles with the apical tooth vestigial and with only one medial tooth.

Pheidologeton diversus (Jerdon)
(Pl. 6, figs. 8-16)

MATURE WORKER LARVA: Length about 2.1 mm. Short and stout; prothorax forming a stout neck, which is bent ventrally to a right angle; dorsal profile C-shaped, ventral profile of abdomen nearly straight; diameter greatest at abdominal somites III and IV. Anus ventral. Leg vestiges present. Segmentation indistinct. Mesothoracic spiracle a third larger than the metathoracic, the others diminishing slightly toward the posterior end. Integument of dorsal surface of posterior somites sparsely spinulose, the spinules minute and isolated or in very short rows; on the ventral surface of the thorax and abdominal somites I and II they are in longer rows. Body hairs moderately numerous and short. Of three types: (1) deeply bifid, about 0.054 mm, with the branches curling away from each other and enlarged at the tip, the most abundant type, absent from the ventral surface; (2) bifid, 0.024-0.054 mm, with the branches acuminate and nearly straight, a few on the ventrolateral surfaces; (3) simple, about 0.024 mm, a few on the ventral surface; there are intergrades between the several types; a few hairs on the ventral surface have alveolus and articular membrane. Head large; cranium suboctagonal, but with the angles rounded, slightly broader than long. Antennae small, each with three (rarely four) sensilla each bearing a spinule. Head hairs few, short (0.006-0.036 mm), simple or with the tip denticulate. Labrum short and broad (breadth $3\times$ length); subrectangular, with the ventral corners rounded; each half of anterior

surface with 5-6 sensilla; ventral border with a few spinules and two isolated sensilla; posterior surface with 5-6 sensilla and three spinulose areas, a central area of minute spinules arranged in a few scattered short rows and two ventrolateral areas of coarse isolated spinules. Mandibles small, short, stout and thick; apex forming a small tooth which is curved medially and posteriorly; with two small medial teeth near the anterior surface. Maxillae with the apex paraboloidal; palp a low elevation bearing four sensilla; galea a low knob bearing two sensilla. Anterior surface of labium sparsely spinulose, the spinules isolated or in short transverse rows; palp represented by a cluster of four sensilla; an isolated sensillum between each palp and the opening of the sericteries; the latter a short transverse slit.

YOUNG LARVA: Length about 1.1 mm. Thorax bent ventrally to an acute angle; diameter nearly uniform but greatest at the third and fourth abdominal somites. Head relatively very large. Posterior end forming a knob which is directed posteroventrally. Otherwise as in the mature larva.

Material studied: two dozen larvae from the Philippine Islands.

EXPLANATION OF PLATE 6

Oligomyrmex parvicornis Forel, Figs. 1-7 —1, head in anterior view, $\times 115$; 2, left mandible in anterior view, $\times 303$; 3 and 4, two body hairs, $\times 418$; 5, first instar larva in side view, $\times 39$; 6, young larva in side view, $\times 39$; 7, mature larva in side view, $\times 39$.

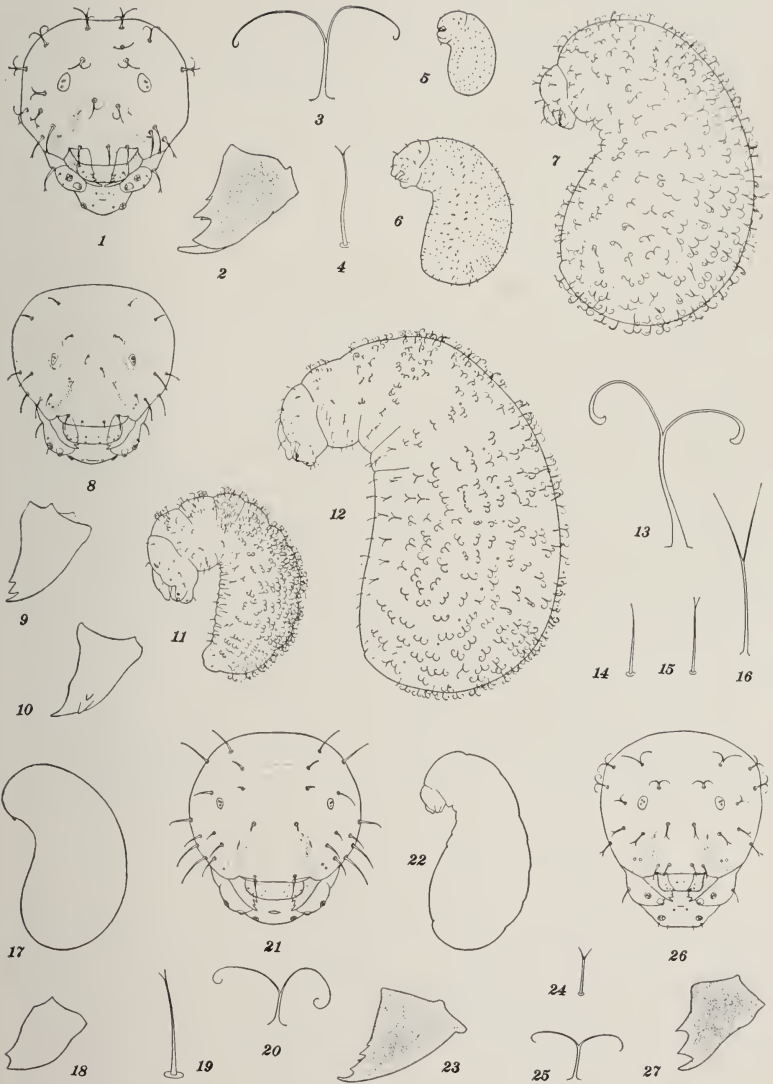
Pheidologeton diversus (Jerdon), Figs. 8-16 —8, head in anterior view, $\times 77$; 9, left mandible in anterior view, $\times 209$; 10, left mandible in medial view, $\times 209$; 11, young larva in side view, $\times 36$; 12, mature larva in side view, $\times 36$; 13-16, four body hairs, $\times 418$.

Pheidologeton affinis (Jerdon), Figs. 17 and 18 —17, profile of sexual (?) larva, $\times 2.7$; 18, left mandible of sexual (?) larva in anterior view, $\times 209$.

Carebara winifredae Wheeler, Figs. 19 and 20, two body hairs, $\times 418$.

Carebara lignata Westwood, Figs. 21-23 —21, head in anterior view, $\times 108$; 22, profile of worker larva, $\times 18$; 23, left mandible in anterior view, $\times 245$.

Paedalgus termitolestes Wheeler, Figs. 24-27 —24 and 25, two body hairs, $\times 329$; 26, head in anterior view, $\times 132$; 27, left mandible in anterior view, $\times 303$.



WHEELER AND WHEELER — MYRMICINE LARVAE

Pheidologeton affinis (Jerdon)

(Pl. 6, figs. 17-18)

SEXUAL (?) LARVA: Length straight from end to end 8 mm; length from head to anus through spiracles about 12 mm. Voluminous, plump and turgid, bean-shaped. Head exceedingly minute, on the ventral surface near the anterior end. Mandibles somewhat smaller; apical tooth vestigial; only one medial tooth. Otherwise similar to *diversus* worker larva. (Material studied: six larvae from Dutch New Guinea; hairs broken off.)

Genus *Oligomyrmex* Mayr

Short and very stout; prothorax forming a short, very stout neck which is bent ventrally to a right angle; dorsal profile C-shaped, ventral sinuate; diameter greatest at abdominal somites IV and V. Body hairs short and moderately numerous. Of two types: (1) deeply bifid, with the branches curling away from each other, the most abundant type, absent from the ventral surface of the thorax; (2) a few on the ventral surface, with short-bifid tip. Head hairs few, short, varying in arrangement and shape. Labrum small and subrectangular; posterior surface sparsely spinulose. Mandibles with a long slender apical tooth which is curved medially; a large subapical tooth on the anterior surface; an acute medial tooth arising from the posterior surface near the middle of the mandible; one or two additional medial teeth may be present. Maxillary and labial palps each represented by a cluster of four sensilla; galea a low knob.

Oligomyrmex parvicornis Forel

(Pl. 6, figs. 1-7)

MATURE WORKER LARVA: Length about 1.5 mm. Short and very stout; prothorax forming a short, very stout neck which is bent ventrally to a right angle; dorsal profile C-shaped, ventral sinuate; diameter greatest at abdominal somites IV-V. Anus ventral, with a posterior lip. Segmentation indistinct. Mesothoracic spiracle a third larger than the metathoracic and first abdominal (which are equal), the others exceedingly minute (one-third the size of the mesothoracic). Integument of midventral surface of thorax

and abdominal somites I and II with a few long transverse rows of spinules. Body hairs moderately numerous, uniformly distributed, short. Of two types: (1) deeply bifid, 0.036-0.054 mm, with the branches curling away from each other, the most abundant type, absent from the ventral surface of the thorax (a few of this type are trifold or have the branches denticulate), without alveolus and articular membrane; (2) a few hairs on the ventral surface, 0.018-0.045 mm, with short-bifid tip, with alveolus and articular membrane. Head large; cranium suboctagonal in anterior view, slightly broader than long. Antennae with three (rarely two) sensilla, each bearing a short spinule. Head hairs few, short (0.018-0.036 mm), varying in arrangement and shape (simple or bifid or trifold or with short-bifid tip or long-branched with a few denticles.) Labrum small, short and broad (breadth $3\times$ length); subrectangular, with the ventral corners rounded; anterior surface with four minute hairs, four sensilla and a few spinules; ventral border spinulose; posterior surface with six isolated sensilla and a few spinules. Mandibles heavily sclerotized; a trifle stout; apex forming a long slender tooth which is curved medially; a large subapical tooth on the anterior surface; an acute medial tooth arising from the posterior surface near the middle of the mandible; one or two additional medial teeth may be present. Maxillae with the apex paraboloidal; palp a cluster of four sensilla, two of which bear each a spinule and two a cap; galea a short knob with two sensilla. Anterior surface of labium sparsely spinulose, the spinules minute and in short rows; palp a cluster of four sensilla, two of which bear each a spinule and two a cap; a minute hair between each palp and the opening of the sericteries; the latter a short transverse slit.

FIRST INSTAR LARVA: Length about 0.27 mm. Body short, stout and subovoidal. Head very large, ventral. Hairs simple, about 0.006 mm long. Integument of dorsal surface with spinules in short transverse rows.

SECOND INSTAR LARVA: Similar to the first instar but with hairs up to 0.009 mm long.

YOUNG LARVA: Length about 0.73 mm. Short and stout with the prothorax curved ventrally to a right angle. Head very large. Body hairs very short (0.006-0.018 mm), most

hairs on the ventral surface straight, with simple or bifid tip; elsewhere varied (simple and straight or flexible, or with bifid tip or deeply bifid). Integument of dorsal surface of abdominal somites VI-X with spinules in short transverse rows; a few minute spinules on the venter of the prothorax.

YOUNG LARVA: Length about 1.1 mm. Similar to mature larva.

Material studied: two dozen larvae from Queensland; courtesy of Dr. W. L. Brown.

Oligomyrmex jacobsoni Forel

Length about 1.36 mm. Body hairs shorter. With a sensillum between each palp and the opening of the sericteries. Otherwise as in *parvicornis*. (Material studied: numerous larvae from Java.)

Oligomyrmex mjöbergi Forel

Very similar to *parvicornis*. (Material studied: numerous larvae from Queensland; courtesy of Dr. W. L. Brown.)

Oligomyrmex thoracicus Weber

Weber, 1950, pp. 16-17: "The 6-mm. cell contained worker and female pupae, the latter 3.3 mm. in length, and a few larvae which could have been only female, being 1.8-2.3 mm. long. Early worker pupae were enclosed in the larval skin, the latter being 0.9 mm. long. The female larvae were as plump as those of *Atta*, one 1.8 mm. long having an abdominal diameter of 1.1 mm. and a head capsule of 0.25 mm. situated completely on the ventral side; no hairs were apparent. Worker larval skins on the other hand were covered with short hairs, bifurcate or trifurcate apically."

Oligomyrmex (Aëromyrma) sundaicus Forel

Very similar to *parvicornis*. (Material studied: 18 damaged larvae from Java.)

Genus EREBOMYRMA Wheeler

Short and stout; curved ventrally; posterior end conoidal and directed ventrally. Labrum small and subrectangular; the posterior surface sparsely spinulose. Mandibles with apex forming a long slender acute tooth which is curved medially; anterior surface with two large medial teeth. Maxillary and labial palps each represented by a cluster of four sensilla.

Erebomyrma sp.

(Text fig. 1, G-I)

Length about 2 mm. Short and stout; curved ventrally; posterior end conoidal and directed ventrally; anus at the tip of the conoid, with a conspicuous posterior lip; head ventral near the anterior end. Segmentation indistinct. Dorsal surface of posterior somites sparsely spinulose, the spinules minute and in very short transverse rows; ventral surface of anterior somites with more numerous and longer rows. Head large, subpyriform in anterior view. Each antenna with three sensilla, each of which bears a spinule. Labrum small, subrectangular in anterior view, short and broad (breadth $2.3 \times$ the length); anterior surface with four minute hairs, four sensilla and a few spinules; ventral border with six sensilla and a few spinules; posterior surface with four isolated sensilla and a few short rows of minute spinules. Mandibles heavily sclerotized; somewhat stout; apex forming a long slender acute tooth which is curved medially; posterior surface with one large medial tooth; anterior surface with two large medial teeth; medial surface may have a single denticle near the base. Maxillae rather small, lobose; palp a short frustum with four sensilla; galea a short subcone with two sensilla. Anterior surface of labium spinulose, the spinules minute and in short rows; palp represented by a cluster of four sensilla; an isolated sensillum between each palp and the opening of the sericteries; the latter a short transverse slit. (Material studied: two damaged larvae from Costa Rica; hairs broken off.)

Genus *Carebara* Westwood

Shaped somewhat like a crookneck squash; thorax forming a short, stout neck which is strongly curved ventrally; abdomen somewhat swollen. Body hairs moderately numerous and short. Of two types: (1) deeply bifid, with the branches curled away from each other, the most common type; (2) a few with short-bifid tip, restricted to ventral and ventrolateral surfaces. Antennae small. Head hairs few, short, simple. Labrum small and subrectangular; the posterior surface apparently without spinules. Mandibles small, short and stout; apex forming a short slender tooth;

two small medial teeth arise from the anterior surface and one from the posterior. Maxillary and labial palps each represented by a cluster of four sensilla.

Eidmann (1944, p. 458) characterized the sexual larvae of this genus as gigantic (*riesig*).

Wheeler, 1922, p. 171: The larvae of the sexual forms are "so voluminous that they could not be moved by the workers and are so soft and vulnerable that they would have to be reared in chambers inaccessible to the termites."

Carebara lignata Westwood

(Pl. 6, figs. 21-23)

MATURE WORKER LARVA: Length about 2 mm. Shaped somewhat like a crookneck squash; thorax forming a short, stout neck which is strongly curved ventrally; abdomen somewhat swollen; posterior end round. Anus postero-ventral. Segmentation indistinct. Spiracles uniform in size. Integument of ventral surface of thorax with rather long transverse rows of spinules. Cranium subcircular in anterior view. Antennae small, each with three sensilla, each of which bears a spinule. Head hairs few, short (0.027-0.045 mm), simple, slightly curved. Labrum small, short and broad (breadth $3\times$ length); subrectangular, but with the ventral corners rounded; anterior surface with about 10 sensilla; ventral border with a couple of isolated sensilla and with a few spinules at either side; posterior surface with six sensilla. Mandibles small, short and rather stout; apex forming a short slender tooth; two small medial teeth arise from the anterior surface and one from the posterior. Maxillae with the apex paraboloidal; palp represented by a cluster of four sensilla (two encapsulated and two bearing a spinule each); galea a short frustum bearing two apical sensilla. Anterior surface of labium spinulose, the spinules minute and in very short transverse rows; palp a cluster of four sensilla (two encapsulated and two bearing a spinule each); opening of sericteries a short transverse slit. (Material studied: numerous damaged larvae from Java.)

Carebara winifredae Wheeler

(Pl. 6, figs. 19-20)

MATURE WORKER LARVA: Length about 2 mm. Body hairs

moderately numerous and short. Of two types: (1) about 0.036 mm long, deeply bifid, with the branches curled away from each other, without alveolus and articular membrane, the most common type; (2) a few, 0.027-0.045 mm long, with short-bifid tip, with alveolus and articular membrane, restricted to the ventral surface of the abdomen and to the ventral and ventrolateral surfaces of the thorax. Integument of ventral surface of thorax and abdominal somites I and II with rather long transverse rows of spinules. Labium with an isolated sensillum between each palp and the opening of the sericteries. Otherwise similar to *lignata*. (Material studied: a dozen damaged larvae from British Guiana.)

Genus *Paedalgus* Forel

Abdomen spheroidal; thorax forming a short stout neck which is arched ventrally. Body hairs short and moderately numerous. Of two types: (1) deeply bifid, with the branches curling away from each other, the most abundant type; (2) a few with bifid tip, on the ventral surface. Head hairs few and short, those above the antennal level deeply bifid, those below with bifid tip. Labrum small and sub-rectangular; posterior surface apparently without spinules. Mandibles short and stout; anterior surface produced into a medial blade which bears two stout medial teeth; posterior surface with one medial tooth. Maxillary and labial palps each represented by a cluster of four sensilla.

Wheeler, 1922, p. 119: "That the salivary glands may be important as exudate organs throughout life is indicated by certain genera of Myrmicinae (e.g., *Paedalgus*), the larvae of which have no exudatoria but greatly developed salivary glands, though the latter are never used for spinning cocoons in the prepupal stage." (Mentioned by Wheeler 1928, p. 233 = 1926, p. 281.)

Paedalgus termitolestes Wheeler

(Pl. 6, figs. 24-27)

Abdomen spheroidal; thorax forming a short stout neck which is arched ventrally; segmentation indistinct (according to W. M. Wheeler). Integument of ventral surface of thorax with rather long transverse rows of minute

spinules. Body hairs moderately numerous, uniformly distributed and short. Of two types: (1) deeply bifid, about 0.036 mm long, with the branches curling away from each other, the most abundant type, without alveolus and articular membrane, absent from the ventral surface; (2) a few on the ventral surface, about 0.018 mm long, nearly straight, with the tip bifid, with alveolus and articular membrane. Cranium transversely subelliptical in anterior view, slightly broader than long. Antennae each with three sensilla, each of which bears a spinule. Head hairs few, short (about 0.027 mm), those dorsal to the antennal level deeply bifid, ventral to the antennal level with bifid tip. Labrum small, short (breadth $2.2 \times$ length); subrectangular, but with the ventral corners rounded; anterior surface with about ten sensilla; posterior surface with about six sensilla. Mandibles short, stout and heavily sclerotized; apex slender and curved medially; anterior surface produced into a medial blade which bears two stout medial teeth; posterior surface with one medial tooth. Maxillae with the apex paraboloidal; palp represented by a cluster of four sensilla (two encapsulated and two bearing a spinule each); galea a short frustum with two apical sensilla. Anterior surface of the labium with a few rows of minute spinules; palp represented by a cluster of four sensilla (two encapsulated and two bearing a spinule each); an isolated sensillum between each palp and the opening of the sericteries; the latter a short transverse slit. (Material studied: a single damaged integument from the Congo.)

Bischoff (1927, pp. 94-95) cited Wheeler (1918) on trophallaxis in this species.

Forel (1922, p. 83 = 1928, Vol. I, pp. 462-463) cited the same.

Wheeler, 1918: "The larva has a singular shape, being almost spherical, with a short neck, small head and minute, bidenticulate mandibles. The delicate integument is studded with very short, stiff hairs, each of which has two recurved branches. The larvae, which are held together in compact masses by the interlocking of these hooked hairs, are fed with liquid food by regurgitation as is evident from the contents of their large spherical stomachs and the very feeble development of their mouthparts. Although, like

other Myrmicinae, they do not spin cocoons but form naked pupae, they nevertheless possess huge salivary glands. Even in the very young larva the salivary receptacle on each side is full of a clear liquid secreted by the large cells of the two branches of the gland. In the nearly full-grown female larva the glands are very voluminous and their lumen and that of the receptacle full of secretion shown as dark, compact masses in the figure, which was, of course, drawn from a specimen hardened and dehydrated in alcohol. As such an amount of saliva would hardly be necessary for digestive purposes and as it is not used in the form of silk by the full-grown larva, it probably serves as a store of food for the nurses. The *Paedalgus* larvae, therefore, would seem to resemble the repletes of honey ants . . . except that the food for the workers is metabolized and stored as saliva by the larva, instead of merely being ingurgitated and stored in the ingluvies, or crop by a certain number of workers. From the fact that other Myrmicine ants, although they spin no cocoons, often have well-developed salivary glands, we may infer that these organs have much the same function as in *Paedalgus*" (pp. 301-302). Fig. 5 on p. 303: *A*, very young larva in side view showing internal anatomy; *B*, nearly mature female larva in side view showing salivary glands.

Wheeler, 1922: "They are white, nearly spherical, with short neck, small head, and very feebly developed mouth-parts, indicating that they are fed by the tiny workers with regurgitated liquid food. They are . . . covered uniformly with short, stiff, sparse hairs, each of which has two recurved branches. Even in alcohol, the larvae cling compactly together in masses by means of these hooks. When stained and cleared, the larvae are seen to possess unusually voluminous salivary glands. The youngest individuals, scarcely 0.2 mm. long, have the receptacle full of clear secretion. In older larvae, the secretion after dehydration forms great masses in the receptacles and lumen of the glands. As these organs are not used in spinning a cocoon, it is very probable that the secretion . . . is elaborated and used as a food for the workers (trophallaxis)" (pp. 179-180). Fig. 43 on p. 179 = Wheeler, 1918, Fig. 5.

In this same article Wheeler concluded (pp. 118-119)

from his study of the larvae of *Pachysima* spp. and "*Paedalgus infimus* (*vide infra*) . . . that the young larvae are fed by regurgitation, the older larvae with pellets of crushed insects, and that, especially during their younger stages, the larvae are so assiduously fed and cared for because they furnish liquid exudates, small in quantity, to be sure, but of such a quality as to excite the appetite of their nurses and induce regurgitation. I believe that the salivary glands, as soon as they develop, take on the function of supplying exudates." *Infimus* here must be a lapsus for *termitolestes*, since the only subsequent reference is to Santschi's description (see below) and there is no evidence that Wheeler ever studied the larvae of *infimus*.

Paedalgus infimus (Santschi)

Santschi, 1914, p. 365: "Les larves sont glabres." (Mentioned by Wheeler, 1922, p. 179.)

Wheeler, 1922, p. 118: See last paragraph under *P. termitolestes* above.

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SOME NEW SYNONYMS IN CLYTRINAE
(COLEOPTERA, CHRYSOMELIDAE)

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I list some new synonyms in Clytrinae, which have been established in the course of my work in connection with Junk's second edition of the "Coleopterorum Catalogus".

Not all the names in this list are plain synonyms; in most cases they represent different color patterns or minor differences in size and microsculpture which tend to be lost in large series. In my opinion, none of these differences is of either specific or subspecific value.

I have seen specimens (in several cases types or specimens from the typical series and typical locality) of all the names listed below.

Macrolenes (Plecomera) quadraticollis Lacord. from South Africa. Lacordaire, 1848, Mon. Phyt. II, p. 105 ♂.

= *M. (P.) varipes* Jacoby, 1901, Trans. Ent. Soc. Lond., 1901, p. 217, pl. 10, f. 5.

Antipus (Gyriodera) cruciata (Thunb.) from South Africa. Thunberg, 1821, Nova Acta Upsala, 8, p. 184.

= *A. (G.) clitellata* Lacordaire, 1848, Mon. Phyt. II, p. 124.

Anomoea laticlavia (Forst.) from the United States and Central America. Forster, 1771, Nov. Spec. Ins., p. 27.

= *A. rufifrons* Lacordaire, 1848, Mon. Phyt. II, p. 135.

= *A. villosa* Jacoby, 1888, Biol. Centr. Amer. Col. 6, 1, Suppl., p. 67, pl. 36, f. 17 ♂.

Diapromorpha (Peploptera) eckloni Lacord. from south east Africa. Lacordaire, 1848, Mon. Phyt. II, p. 244.

= *D. (P.) dorsata* Lacordaire, l.c., p. 245.

Diapromorpha (Peploptera) postica Lacord. from equatorial Africa. Lacordaire, l.c., p. 251.

= *D. (P.) arcuata* Clavareau in Jacoby and Clavareau, 1906, Gen. Ins., fasc. 49, p. 28, footnote.

Diapromorpha (Peploptera) trilineata Lacord. from South Africa. Lacordaire, 1848, Mon. Phyt. II, p. 246.

= *D. (P.) schenklingi* Clavareau, 1909, Ann. Soc. Ent. Belg., 53, p. 386.

- Diapromorpha (Peploptera) abyssinica* Lef. from Ethiopia.
Lefèvre, 1877, Rev. Mag. Zool., (3)5, p. 225.
= *D. (P) schimperi* Lefèvre, 1891, Ann. Soc. Ent. Belg.,
35, c.r. p. CCLI.
- Diapromorpha (Peploptera) curvilinea* Jac. from South
Africa. Jacoby, 1901, Trans. Ent. Soc. Lond., 1901. p.
222, pl. 10, f. 9.
= *D. (P.) braunsi* Jacoby, 1903, Ent., 36, p. 92.
- Diapromorpha (Aspidolopha) spilota* (Hope) from Nepal
and Burma. Hope in Gray, 1831, Zool. Misc., p. 30 (*Cryp-
tocephalus*).
= *D. (A.) thoracica* Jacoby, 1892, Ann. Mus. Civ. Geno-
va, 32, p. 879.
- Melitonoma (M.) decempunctata* (Oliv.), 1808, Ent., 6, pl.
2, f. 24 from tropical and equatorial Africa.
= *M. (M.) patruelis* Lefèvre, 1891, Ann. Soc. Ent. Belg.,
35, c.r. p. CCLII.
= *M. (M.) pedestris* Lefèvre, l.c., p. CCLIII.
= *M. (M.) polysticta* Lacordaire, 1848, Mon. Phyt. II,
p. 372.
= *M. (M.) maculigera* Lacordaire, l.c., p. 376.
= *M. (M.) sobrina* Lacordaire, l.c., p. 377.
= *M. (M.) litigiosa* Lacordaire, l.c., p. 378.
- Megalostomis (Megalostomis) amazona* Jac. from tropical
America. Jacoby, 1876, Proc. Zool. Soc. Lond., 1876, p.
809.
= *M. (M.) generosa* Baly, 1877, Cist. Ent., 2, p. 181.
= *M. (Minturnia) mariae* Monrós, 1951, Ann. Mag. Nat.
Hist., (12)4, p. 1154, f. 7-9.
- Megalostomis (Megalostomis) anachoreta* Lacord. from
Central and northern South America.
Lacordaire, 1848, Mon. Phyt. II, p. 537.
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= *U. godmani* Jacoby, 1879, Proc. Zool. Soc. Lond., 1879,
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Babia quadriguttata (Oliv.) from the United States and Central America. Olivier, 1791, Enc. méth., 6, p. 37.

= *Babia distinguenda* Jacoby, 1888, Biol. Centr. Amer. Col. 6, 1, Suppl., p. 82.

= *Babia amplicollis* Jacoby, l.c., p. 83.

= *Babia parvula* Jacoby, l.c., p. 83.

Babia rufipennis Lacord. from Brazil.

Lacordaire, 1848, Mon. Phyt. II, p. 433.

= *Babia undabunda* Lacordaire, l.c., p. 433.

TWO NEW TINGIDAE (HEMIPTERA)¹

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This paper contains the descriptions of two new species of lacebugs, one from Australia and the other from the West Indies. The specimens were kindly sent to me by Dr. P. J. Darlington, Museum of Comparative Zoology, Harvard University. The types have been returned to the above Museum.

Teleonemia lustrabilis new sp.

Large broad, blackish fuscous with a slight tinge of ferruginous. Length, 5.15 mm; width, 2.60 mm.

Head with four brownish spines; anterior pair short, porrect; posterior pair appressed, barely attaining base of frontal pair. Bucculae large, reticulate, contiguous in front. Rostrum brownish blackish apically, barely reaching beyond mesosternum; rostral channel wide, not closed behind; laminae not very high, dark fuscous, uniseriate, diverging posteriorly on mesosternum, more widely separate and cordate on metasternum. Orifice large, very conspicuous. Legs slender, smooth, moderately long, ferruginous-fuscous. Antennae moderately long, moderately stout, straight, densely clothed with short, thick, recumbent setae;

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segments I and II very short, only slightly thickened, subequal; III rather stout, three times as long as IV (72:24), the latter barely enlarged. Pleura very coarsely pitted. Thorax beneath dark fuscous, the venter mostly brownish. Hypocostal laminae uniseriate, the areolae rounded. Orifice very large.

Pronotum distinctly transversely convex, coarsely punctate, tricarinate; each carina uniseriate and with dorsal vein strongly incrassate; median carina moderately elevated, distinctly arched on disc, composed of rectangular areolae (higher than wide), with two or three of the areolae longitudinally divided in widest part; lateral carinae less elevated, with dorsal boundary gradually rounded or arched

from base to apex. Hood moderately high, narrow, projecting almost one-third of its length over base of head, with median dorsal vein greatly thickened, a little longer than high. Paranota moderately wide, widest opposite humeral angles, there almost erect and four cells deep, only one cell wide in front, with short hind part back of widest part curved inwardly, the areolae moderately large and clear. Elytra longer and wider than abdomen, widest just behind apex of posterior projection of pronotum, broad and slowly rounded on hind margin, with tips partly overlapping; with exterior marginal vein considerably enlarged; costal area wide, with six dark transverse fasciae (a wide band at widest part of elytron, two narrower ones in front of and three behind wide band, the areolae densely clouded in bands and clear between bands); areolae larger and two deep in clear areas, smaller and three deep in bands; subcostal area wide, mostly triseriate, the areolae smaller than in costal and considerably clouded; discoidal area large, extending a little beyond middle of elytra, narrowed at both ends, with outer boundary sinuate, widest at middle, there five cells deep; sutural area large, the cells becoming larger apically, with several clear cells in apical part.

Holotype (female), Constanza, Dominican Republic, West Indies, 3000-4000 feet elevation, Dr. P. J. Darlington collector.

This large chocolate-colored species with some clear areolae in the costal area as the only characteristic markings is very distinct, and can be readily separated from its congeners by the size, form and the structures of the paranota, carinae and paranota as noted in the description. The outer vein of paranota, median vein of hood and dorsal veins of carinae are unusually incrassate. The clear areolae of costal area of elytra are arranged largely in blocks of two or four, thus giving the dark species a striking appearance.

Australotingis vinnula new sp.

Large, broad, testaceous with areolae hyaline. Head brown, concealed from dorsal aspect by hood; hind pair of cephalic spines long, appressed, testaceous, the median and anterior pair wanting. Length, 4.20 mm.; width, 2.25 mm.

Rostrum brownish with dark apex, extending to base of mesosternum; laminae uniseriate, with inferior edge finely toothed, testaceous, diverging posteriorly, entirely open behind. Bucculae testaceous, areolate, closed in front. Orifice present. Hypocostal ridge narrow, uniseriate. Antennae very long, slender, shortly pilose; segments I and II short, moderately stout, the latter smaller; III long, almost twice the length of IV; IV long, feebly swollen, clothed with longer hairs.

Pronotum moderately convex on disc, distinctly pitted, fuscous-brown, tricarinate, the hood, paranota and carinae testaceous; with clear cells; lateral carinae parallel, with dorsal edge rounded or arched for the entire length, composed of one row of rectangular cells; median carina strongly foliaceous, longer but not as high as hood, with dorsal vein rounded, highest a little back of the hood, there biseriate; hood large, moderately compressed laterally, inflated, longer than high, moderately narrowed anteriorly, strongly sloping downward. In front, with apex extending a little in front of the head. Paranota large, semiglobose, reflexed so that the outer margin projects almost vertically over pronotal surface with anterior and posterior ends curved inwardly. Elytra almost quadrate in outline, abruptly widened near base, much longer and wider than abdomen, with outer margins finely serrate, with apices broadly rounded and a little separated; costal area very wide, composed of large areolae, six cells deep in widest part; basal part of subcostal and discoidal areas jointly elevated so as to form a large tumid elevation; discoidal area not reaching middle of elytra, extending one half of its length beyond apex of hind pronotal process, five areolae deep in widest part, there more strongly inflated. Wings a little longer than abdomen, much shorter than elytra, whitish in color.

Type (male) and 3 *paratypes* (males), Lankelly Creek, McIlwraith Range, Cape York, Queensland, Australia, June 7, 1932, P. J. Darlington.

Separated at once from the only other member of the genus, *A. franzeni* Hacker, by the larger size, larger hood, longer antennae, larger paranota and higher and more arched median carina. The turned in ends of the paranota form a rounded-like opening above the disc of the pronotum.

tum. The lateral carinae are widely separated and terminate behind near the base and outer corners of the triangular pronotal process; anteriorly, they are a little removed from the sides of the hood.

ADDITIONAL NOTES ON BRACHYPANORPA. — In my recent account of *Brachypanorpa* (Psyche, 60:28-36, 1953), I pointed out that all known females of *B. carolinensis* (Banks) collected from 1905 through 1920 were short-winged and flightless, whereas all those collected since 1951 were long-winged and able to fly. I also noted that I had not located any specimens of this insect which had been collected during the interval between 1920 and 1951. Dr. J. Anthony Downes has more recently informed me that he collected *carolinensis* in the Black Mts., North Carolina, on June 10, 1938; the locality (near Mt. Mitchell, Toe River Gap, elevation 5500') is the one at which my long-winged females were found in 1951 and 1952. Dr. Downes writes me that the females were "unable to fly but readily jumped several inches." One of the four females which he collected was sent to me for examination; it is clearly the short-winged type, like those originally found by Banks. The occurrence of these four females in 1938 indicates that the long-winged specimens had not appeared by that year (or at any rate that they were much in the minority) and that the female population did not change until after that time. Since I was unable to visit the *carolinensis* localities in the spring of 1953, I should also note that Mr. P. W. Fattig collected several long-winged females at Unicoi Gap., Georgia, on May 31, 1953, at the same locality that yielded numerous specimens in 1952.

A second female of *B. montana* Carp. was also recently sent to me by Dr. Downes, who collected it on Mt. McLoughlin, Oregon (June 25, 1939, 5000' elevation). This is the type locality of the species, originally described from a series of nine males. The new specimen agrees with the individual illustrated in my 1953 paper. — F. M. CARPENTER, Harvard University.

CICINDELIDAE (TIGER BEETLES) COLLECTED IN
EASTERN NEW GUINEA, WITH DESCRIPTION OF
A NEW SPECIES¹

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From material loaned to me by the Museum of Comparative Zoology, Cambridge, Massachusetts, U.S.A., I have compiled the following list, with notes, of tiger beetles collected in New Guinea by P. J. Darlington, Jr. during the recent war.²

1. *Cicindela tetrachoides* Gestro

Eight specimens collected at Dobodura, Papua.

2. *Cicindela darlingtoni* n. sp.

(Figs. 1-3, 6-7)

Resembles *C. latreillei* Guer., but differs by larger scutellum, longer pronotum, more dense curly pubescence on the underside, and especially by the hairs on the side margin of the labrum and the row of stiff hairs on the middle tibia (Figs. 1, 2). Head of male green; labrum strongly projecting, more rounded than in *latreillei*, yellow with dark margin, front margin with a small obtuse tooth at centre, side margin except anteriorly with a row of small hooked hairs; mandibles yellow, tips dark; palpi yellow, outer part of the last segment dark except at extreme tip. Head of female blackish; labrum black with green luster. Antennae with first 4 segments dark metallic, the rest pubescent. Prothorax more elongate than in *latreillei*, constricted near the base, with distinct but fine median line, and slightly transversely striated; apical edge with fine yellow hairs,

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²Two additional species, *Caledonomorpha milneana* and *Prothyma papua*, have been described by Dr. Darlington in *Psyche*, Vol. 54, 1947, pp. 241-245. Darlington's collecting localities are shown on his sketch map in the *Bulletin of the Museum of Comparative Zoology*, Vol. 107, 1952, p. 93.

basal edge especially at the angles with longer gold-colored hairs. Elytra of male more shining and less velvety than in *latreillei*; of female not shining but dull; of both sexes finely and rather densely punctured, with humeral spot and narrow apical margin yellow; epipleurae and apical third of suture of male yellow, of female scarcely so. Apex of each elytron separately rounded. Male below with coxae, metasternum, and sternites (except first and margin of second) yellow, the rest shining green; episterna of pro-, meso- and metathorax, mesosternum, margin of the metasternum, and first sternite with dense, curly hairs; legs yellow, femora with greenish luster; basal $\frac{2}{3}$ of femora with long, curly hairs; tarsi dark; apex of the protibiae with stiff hairs; meso-tibiae outwardly with a fringe of short pale bristles; meta-tibiae compressed; claws long. Female with pubescent parts of underside metallic green and the rest dark; trochanters yellow; legs darker than in male, with tibiae yellow. Male copulatory organs as figured (Fig. 3).

Length: 12.5 mm. (without labrum).

Holotype ♂ and allotype ♀ in the Museum of Comparative Zoology (Type No. 28,997) and 1 ♀ paratype in my collection all from DOBODURA, PAPUA, collected by P. J. Darlington Jr., for whom, of course, the species is named.

3. *Cicindela decemguttata urvillei* Dej.

(Figs. 4-5)

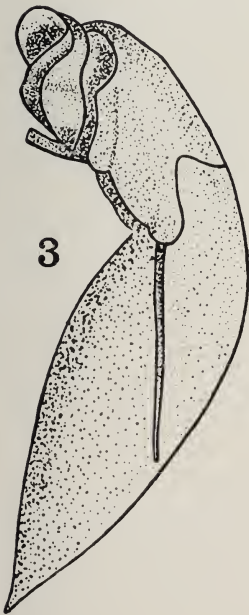
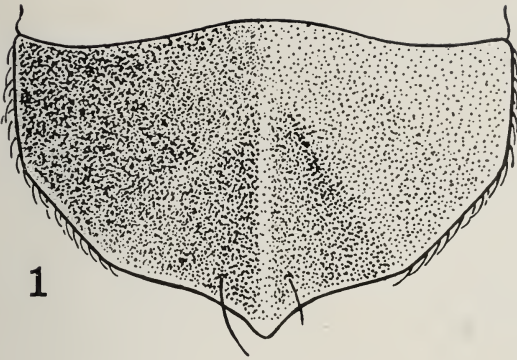
Of the six specimens, from Dobodura and Milne Bay, belonging to this subspecies only two have the typical markings of *urvillei* Dej. The other specimens are aberrations which need not be named but are worth mentioning here. They are (a) two specimens without the humeral top-fleck (Fig. 4); and (b) two specimens with the discal spot connected with the upper marginal spot, which is in turn connected with the lower marginal spot (Fig. 5). One specimen of "a" has one elytron as in "b".

4. *Cicindela discreta* Schaum.

Two specimens from Dobodura, Papua.

EXPLANATION OF PLATE 7

Figs. 1-3, *Cicindela darlingtoni*, n. sp.—1, labrum; 2, middle tibia; 3, male genitalia. Figs. 4-5, *Cicindela decemguttata urvillei* Dej.



5. *Cicindela semicineta* Brullé

Four specimens from Dobodura, Papua, which are totally black. These are to be considered as a nigra-form of *semicineta* Brullé.



Figs. 6-7. *Cicindela darlingtoni*, n. sp. Fig. 6, male; fig. 7, female.

6. *Cicindela io* W. H.

Three specimens from Milne Bay, Papua.

7. *Cicindela io microgemmea* W. H.

Dobodura, Papua, four specimens.

8. *Cicindela bennigsenia* W. H.

Walter Horn observed in *Records of the South Australian Museum*, 1932, page 551, that males of *Cicindela bennigsenia* collected on the Mount Lamington Plateau in N. E. Papua differ in shape of labrum from the specimens described by him. A male collected by Dr. Darlington at Dobodura has a labrum of the same shape as the Mount Lamington males. The labrum is rather strongly excavated at middle, without the slightest trace of a sagittal tooth.

9. *Cicindela funerata barbata* W. H.

Of this subspecies there are six examples from Dobodura, three from Milne Bay, two from vicinity of Nadzab, and thirteen from Morobe District (Surprise Creek). The first two of these localities are in Papua; the other two, in N.E.N.G. Specimens from the different localities differ slightly in color. Those from Milne Bay are more greenish; from Nadzab, more reddish; and from Surprise Creek, darker than those from Dobodura. In three examples (one from Milne Bay and two from Surprise Creek) the humeral lunule is divided into two separate spots. The penis, clearly visible in several males, shows slight differences even among specimens from the same locality.

10. *Cicindela guineensis umbrosa* W. H.

Dobodura, Papua, six specimens.

11. *Cicindela ancorifera* W.H.

Four examples from Chimbu Valley (Bismarck Rge.), 5,000-7,500 ft. altitude, and five from Morobe District, Mt. Misim, 6,400 ft. (both localities in N.E.N.G.). These specimens possess middle and apical white spots on each elytron. Typical specimens ought to have three white spots. Of about 40 examples I have seen from the London and Leiden museums almost all had only the middle spot, and only a few a slight indication of the apical spot. As I have already mentioned in *Notes from the Museum Leyden*, I am of the opinion that these are merely aberrations.

THE INDO-AUSTRALIAN SPECIES OF THE ANT
GENUS *STRUMIGENYS* FR. SMITH: GROUP OF
DORIAE EMERY¹

BY WILLIAM L. BROWN, JR.

Museum of Comparative Zoology, Harvard University

The *Strumigenys doriae* group includes three rather large species of uniform aspect with a scattered distribution in the East Indies. The mandibles are greatly simplified, evidently through loss of structures, and are like those of the Neotropical *elongata* group in lacking entirely preapical teeth or distinct dentiform angles in the preapical position. The apical fork teeth are strong and spiniform, straight or nearly so; an intercalary denticle may be present or absent. Mandibular blades straight, slightly narrowed at insertions; vertex raised and convex; occipital lobes strongly depressed; posterior excision deep. Labrum transverse, with a narrow, apically truncate extension on each side extending laterally beyond the lateral borders of the closed mandibles. Legs and antennae long and slender; funicular segment IV elongate. Body, including legs with very long, fine outstanding hairs. In the two species actually examined (*S. bryanti* and *S. ulcerosa*), the sculpture of certain areas is modified to include coarse pits and larger, shallow, margined crateriform areas in bilaterally paired positions. These regions are ordinarily plated or encrusted with a light-colored granular substance, which, when removed by soaking, leaves uncovered impressed areas filled with short, fine dense pile. The whole apparatus appears to be secretory in function, though for what purpose, it is still not known.

These structures, which I refer to as secretory pits and lacunae, appear to be special intensive developments of a widespread general tendency among strumigenite species to produce a granular integumental covering. This covering is not an artifact, since it can be seen in living speci-

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mens in nature and in the artificial nest in a certain proportion of individuals in most colonies at any given time. Its structure is vaguely granular, and appears to be too amorphous to represent a vegetable growth. It is highly resistant to organic solvents, and even to strong acids and bases up to the point where these begin to attack the integument itself. It can sometimes be loosened in water, but does not show appreciable reduction after prolonged soaking. It appears most likely to be a direct secretion of a largely proteinaceous nature. Similar-appearing incrustations are frequent in the myrmicine tribes Basicerotini and Attini, though phylogenetic relationships between these and the Dacetini (*Strumigenys*, etc.) do not appear to be very close. Most species showing the secretion in the Basicerotini and Dacetini show other structural and behavioral convergences, and are, generally speaking, members of the *microgenton* of Silvestri. The dacetines feed chiefly upon certain collembolan families, and it is possible that this secreted crust has something to do with the predatory habit. Among undescribed *Strumigenys* from the New World tropics, I have seen other forms with secretory lacunae, though placed differently to those of the *doriae* group and probably developed convergently.

It is unfortunate that each of the three species treated below is known only from the unique type, a situation which makes taxonomic conclusions somewhat uncertain. The characters given to separate the three are, however, of a degree of distinctness equal to those seen in related *Strumigenys* species known from considerably more satisfactory samples. Emery's brief and somewhat questionable diagnosis with figure of *S. doriae* remains to be checked and amplified by some future specialist having access to the type.

The measurements and their abbreviations are those I have used in various works on the dacetine ants: TL, total length, or sum of lengths of the various tagmata, including the closed mandibles; HL, maximum measurable length of head in dorsal view, including all of clypeus and occipital lobes; ML, distance to which the closed mandibles project beyond the clypeal margin, measured while head is in same position as for HL measurement; WL, diagonal length of ali-

trunk measured from lateral view. The most useful indices are: CI, cephalic index, head width/HL \times 100; MI, mandibulo-cephalic index, ML/HL \times 100.

Strumigenys ulcerosa new species

Holotype worker: TL 4.10, HL 1.09, ML 0.55, WL 1.16 mm.; CI 71, MI 50. Occipital lobes surpass indistinct anterior pronotal margin by approximately 0.1 mm.; this overlap not included in TL.

In general habitus resembling Emery's figure of *S. doriae* (see below), but the mandibles longer and much broader, and the head less broad behind, assuming that Emery's figure approaches the correct proportions for *doriae*. Sides of head in front of occipital lobes feebly concave in outline; eyes moderate in size and convexity, situated distinctly anterior to the cephalic midlength, visible in dorsal view. Clypeus triangular, the anterior border weakly depressed and very feebly concave. Seen from the side, the deepest part of the head is reached at the highest point of the convex vertex, slightly posterior to cephalic midlength; occipital lobes only about half as deep, strongly depressed. Scape L 0.68, funiculus L 0.85 (segment v 0.40, IV 0.24, III + II 0.10, I 0.11 mm.).

Mandibles approximately straight, depressed, broad (slightly less broad than in *S. bryanti* holotype), at bases slightly narrowed and feebly bent inward, broadest at about the apical quarter. Just before the apical fork, the inner border becomes very feebly concave, but there is no preapical angle marking off this concavity, and there is no preapical tooth or denticle. Dorsal tooth of apical fork stoutly spiniform, L 0.14-0.15 mm., only slightly longer than the ventral tooth, which is blunter and approximately parallel; no trace of any intercalary tooth or denticle.

Alitrunk slender, pronotum narrowly rounded anteriorly, without humeral angles, but with a low tubercle on each side; anterior pronotal border obsolete. Pronotum with the entire mesonotum forming one continuous gently arching profile as seen from the side, sloping posteriorly to the well-marked metanotal groove. Propodeal dorsum sloping down posteriorly from the groove, only very feebly convex. Mesosternal groove very broad and deep, taking up ap-

proximately the anterior half of the mesosternum, lined with an abundant erect pile, apparently related to some secretory function. Propodeal teeth reduced to small, inconspicuous, depressed blunt processes, completely involved in the broad, convex infradental lamellae.

Petiole arched-claviform, the node long, low, scarcely differentiated from its peduncle as seen from any view. Ventral spongiform strip fairly well developed, not deep; posterodorsal collar rather broad, ending on each side in well developed posterolateral flaps, each of which is in turn extended as a slender, anteriorly tapered strip forward along the sides of the node about to the level of its indefinite juncture with the peduncle. Postpetiolar node seen from above subcircular, very nearly as long as broad and slightly broader than the petiolar node, convex, closely surrounded by spongiform tissue and with large ventral spongiform lobes. Gaster with a conspicuous thick anteroventral pad of spongiform tissue and fine, short subreclinate hairs, anterodorsally with a flange-like transverse spongiform margin. Basal costulae of first gastric segment rather fine, short, extending about $\frac{1}{4}$ the length of the basal segment in the middle; remainder of gaster smooth and shining, as are the mandibles.

Head, alitrunk and both nodes densely and irregularly punctulate-granulose, opaque. The ground punctulation is relieved at intervals by larger, more irregular secretory pits, most conspicuous on head and promesonotum. The larger secretory lacunae, bordered by a low ridge and usually conspicuous by virtue of the whitish encrustation, appear to be formed of many confluent secretory pits. The largest pair are subcircular, located behind the humeral tubercles, occupying the greater part of the posterolateral pronotal surfaces. Another large linear pair, deep and groove-like, follow the humeral margins on each side; and another pair, adjacent to and surrounding the lateral openings of the mesosternal groove, are also of good size. A smaller, but very distinct groove on each side of the propodeum below the spiracle, running posteriorly onto the infradental lamella. Small lacunae are also found on the anterolateral faces of the petiolar node, dorsolaterally on the propodeum at the bases of the teeth, and on each end

of the metanotal groove. Legs densely and finely punctulate-granulose. Pilosity as described for *S. bryanti* (below), except that in *ulcerosa*, the long, fine erect hairs on the head are more numerous, while those of the gastric dorsum are not so extremely long (maximum length about 0.26 mm.), nor are those on the legs so long as in *bryanti*. In *ulcerosa*, the longest hairs on the gastric dorsum are about half as long as the maximum dorsoventral thickness of the gaster. The dense, fine pile present on alitrunk and nodes much as in *bryanti*, most conspicuous at heavily "glandular" areas, especially humeri and mesopleura.

Color rich medium ferrugineous, appendages and occipital lobes slightly lighter and more yellowish.

Holotype, in the Museum of Comparative Zoology, a unique taken at 700 meters altitude, Kananggar, Soemba, Indonesia (Dammerman, no. 242). This species does not seem to be the worker corresponding to the female of *bryanti*, since the latter has a narrower, not broader, head, and has longer mandibles, differently proportioned funicular segments, longer gastric pilosity, and a minute intercalary denticle in the apical fork. If it be assumed that Emery did not too grossly misfigure his Ambonese species, *doriae*, the latter would be distinct from *ulcerosa* in having shorter, very much more slender mandibles and a notably broader head. Emery's draftsmanship, however, was such that doubts about the distinctness of *ulcerosa* and *doriae* will remain until someone can review Emery's type.

Strumigenys bryanti Wheeler

Strumigenys bryanti Wheeler, 1919, Bull. Mus. Comp. Zool. Harvard 63: 95, female (original description).

Holotype female, alate: Differs significantly in proportions, especially of the mandibles, and also in other minor details, from *S. ulcerosa* and *S. doriae*, but for the most part very similar to at least the first of these. TL 4.63, HL 1.08, ML 0.60, WL 1.25 mm.; CI 69, MI 56; occipital-pronotal overlap 0.1 mm., subtracted from TL. Antennal scapes straight, slender, L 0.70, very feebly incrassate in the apical half; funiculus slender, L 0.88 (segment v 0.40, IV 0.31, II + III 0.08, I 0.09-0.10 mm.).

Mandibles with apical fork of two slender spiniform

teeth, the dorsal tooth virtually straight in its apical half, the ventral tooth parallel to the dorsal and about half as long, its extreme tip gently deflected ventrad; a single minute, acute intercalary denticle present. The dorsal apical tooth is about 0.17 mm. long, or slightly more. Shaft of mandible straight, broad, depressed, slightly narrowed toward base; external border feebly convex, inner border straight, except for brief weakly concave apical and basal stretches, and with dorsal and ventral subcultrate margins. The gentle preapical concavity, just at the point where it joins the straight section of the inner border, bears a very low, obtuse vestige of a translucent angle, just barely perceptible at higher magnifications and then only in certain views. This insignificant vestige is probably homologous with the preapical tooth or angle in the majority of Indo-Australian *Strumigenys* species. The reduction of the preapical tooth can be followed in the series *koningsbergeri*, *formosensis*, *bryanti*, although this series probably does not represent the actually evolved lineage.

The secretory pits and lacunae are arranged much as in the worker of *S. ulcerosa*, but those on the thoracic sclerites are somewhat restricted by the different development of these areas accompanying the presence of the wings. Scutum intricately and rather deeply rugulose-punctulate. Scutellum with similar sculpture; punctulation of mesokatepisternum partially effaced, the surface here more or less smooth and shining. Basal costulae of gaster short and fine.

Head with moderate growth of fine, subreclinate ground hairs, fewer moderately long, fine erect hairs, and fewer still very long, outstanding, fine flagellate hairs, the latter concentrated along the dorsolateral and posterior occipital borders. Scape hairs very fine, reclinate. Alitrunk with numerous long, fine erect hairs, the same, becoming longer and flagelliform on both nodes and gastric dorsum (L up to 0.55 mm.), where some are as long as or nearly as long as the maximum depth of the gaster itself. Legs with very long, fine erect hairs, becoming extremely long and tapered, but fewer, on the posterior surfaces of the metatarsi, where they are often nearly as long as the elongate metatarsus itself. Also present on legs, alitrunk, both nodes and under-

side of head is a dense pile of very fine, short reclinate hairs, inconspicuous except on humeral borders, propodeum and petiolar node; forming a large anteroventral pad at the base of the gaster. The long flagelliform hairs are considerably longer than those of *ulcerosa*.

Color reddish ferrugineous, appendages lighter. Forewing (L 3.1 mm.) with R + Sc, Rsf1, stigma and 2r present and distinct, but not strongly pigmented. Other veins absent or else present only as indistinct folds or lines. The holotype, still the only known specimen, is in the Museum of Comparative Zoology; it was taken on Mt. Matang, West Sarawak, Borneo (G. E. Bryant).

Strumigenys doriae Emery

Strumigenys Doriae Emery, 1887, Ann. Mus. Civ. Stor. Nat. Genova, (2) 5: 45, pl. 2, fig. 22, worker (original description). 1897, Term. Füzetek, 20: 574, worker, in key.

I know this form only from Emery's description and figure, which show it to be very much like *S. ulcerosa* (see discussion above). The original description is very brief, and the figure crude and questionable on several accounts. The mandibles are portrayed as unusually slender for a *Strumigenys* species; nevertheless, Emery definitely says that they are "*cylindricis*" in his description, which, if true, would make them quite different from the broadened and depressed jaws of the two closely related forms. As estimated from the figure, the CI would be about 77, and the MI near 46. Emery's figures of dacetines are known, however, to err rather strongly on occasion in showing correct proportions of head and mandibles. Emery also shows the petiolar and postpetiolar nodes without differentiating the spongiform appendages from the nodes proper. The total length is given as "3½ mm." This is probably too low a figure. Emery does not mention the secretory pits and lacunae that may well be present, but the elongate flagellate hairs characteristic of this species group are indicated in the figure. Color given as "ferruginea, capite obscurior."

The holotype is a unique worker taken at Amboina, East Indies, by Beccari; it is presumably now in the Emery Collection, Museo Civico di Storia Naturale in Genoa, Italy.

PSYCHE

INDEX TO VOL. 60, 1953

INDEX TO AUTHORS

- Beatty, G. H., III. New England Records of *Ululodes* Currie (Neuroptera: Ascalaphidae). 114
- Bequaert, J. Nemestrinidae (Diptera) of Iowa and Missouri. 14
- Brown, W. L., Jr. Three New Ants Related to *Strumigenys louisianae* Roger. 1
- An Australian *Trapeziopelta* (Hymenoptera: Formicidae). 51
- The Indo-Australian Species of the Ant Genus *Strumigenys* Fr. Smith: *S. wallacei* Emery and Relatives. 85
- The Indo-Australian Species of the Ant Genus *Strumigenys* Fr. Smith: Group of *doriae* Emery. 160
- Carpenter, F. M. The Biology of *Brachypanorpa* (Mecoptera). 28
- Additional Notes on *Brachypanorpa*. 154
- Chamberlin, R. V. Two New Oregon Chilopods of the Order Geophilida. 37
- Cheng, F. Y. Three New Species of Panorpidae (Mecoptera). 119
- Creighton, Wm. S. New Data on the Habits of *Camponotus (Myrmaphaenus) ulcerosus* Wheeler. 82
- Darlington, P. J., Jr. Australian Carabid Beetles I. Some *Clivina* from Western Australia. 52
- Australian Carabid Beetles II. Some New Pterostichini. 90
- Drake, C. J. Two New Tingidae (Hemiptera). 151
- Fairchild, G. B. Tabanidae from the State of Chiapas, Mexico, with Descriptions of Two New Species (Diptera). 41
- Gregg, R. E. Taxonomic Notes on the Ant, *Camponotus cooperi* Gregg. 102
- Judd, W. W. Larval Mites of the Genus *Eutrombidium* Attached to a Carolina Locust. 124
- Monrós, F. Some New Synonyms in Clytrinae (Coleoptera, Chrysomelidae). 148
- Nidek, C. M. C. B. van. Cicindelidae (Tiger Beetles) Collected in Eastern New Guinea, with Description of a New Species. 155
- Nutting, W. L. Observations on the Reproduction of the Giant Cockroach, *Blaberus cranüfera* Burm. 6
- The Biology of *Euphasiopteryx brevicornis* (Townsend) (Diptera, Tachinidae), Parasitic in the Cone-headed Grasshoppers (Orthoptera, Copiphorinae). 69
- First Records of the European *Mantis religiosa* (L.) from Maine. 89
- A Gregarine, *Diplocystis*, in the Haemocoel of the Roach, *Blaberus cranüfer* Burm. 126
- Pechuman, L. L. A New Neotropical *Chrysops* (Diptera, Tabanidae). 115
- Shaw, F. R. Some New Diptera with Remarks on the Affinities of the Genus *Pnyxia* Joh. 62
- Werner, F. G. Further Notes on North American *Epicauta*, with New Synonymy (Coleop., Meloidae). 105
- Wheeler, G. C., and J. Wheeler. The Ant Larvae of the Myrmicine Tribe Pheidologetini. 129
- Wilson, E. O. On Flanders' Hypothesis of Caste Determination in Ants. 15
- Young, F. N. Two New Species of Water Beetles from Florida (Coleoptera: Dytiscidae). 21

INDEX TO SUBJECTS

All new genera, new species and new names are printed in LARGE AND SMALL CAPITAL TYPE.

- Additional Notes on *Brachypanorpa*, 154
 Ant Larvae of the Myrmicine Tribe Pheidologetini, 129
 Ants, 1, 15, 85, 102
 Ascalaphidae, 114
 Australian Carabid Beetles, 52, 90
 Australian *Trapeziopelta* (Hymenoptera: Formicidae), 51
Australotingis VINNULA, 152
- Biology of *Brachypanorpa*, 28
 Biology of *Euphasiopteryx brevicornis*, 69
Blaberus craniifer, 126
Brachygeophilus TAMPOPHOR, 39
Brachypanorpa, 154
Brachypanorpa carolinensis, 28
Brachypanorpa montana, 34
Brachypanorpa oregonensis, 33
Bradysia BELLINGERI, 67
Bradysia FARRI, 67
- Camponotus cooperi*, 102
Camponotus (Myrmaphaenus) ulcerosus, 82
 Carabid Beetles, 52, 90
Carebara lignata, 142
Carebara winifredae, 142
 Caste Determination in Ants, 15
 Chilopods, 37
 Chrysomelidae, 148
Chrysops PATRICIA, 115
Cicindela DARLINGTONI, 155
 Cicindelidae (Tiger Beetles) Collected in Eastern New Guinea, with Description of a New Species, 155
Clivina DILUTA, 54
Clivina frenchi, 54
Clivina GRATA, 58
Clivina SCULPTICEPS, 60
Clivina suturalis, 58
Clivina WILUNA, 56
 Clytrinae, 148
 Cone-headed Grasshoppers, 69
Copelatus BLATCHLEYI, 24
 Copiphorinae, 69
- Diplocystis*, 126
 Dytiscidae, 21
- Epicauta diversipubescens*, 110
Epicauta emarginata, 105
Epicauta fallax, 108
Epicauta jimenezi, 110
Epicauta languida, 113
Epicauta ochrea, 106
Epidapus JOHANNSENI, 63
Euphasiopteryx brevicornis, 69
Eutrombidium, 124
- First Records of the European *Mantis religiosa* (L.) from Maine, 89
 Formicidae, 51
 Further Notes on North American *Epicauta*, with New Synonymy (Coleop., Meloidae), 105
- Geophilida, 37
 Gregarine, *Diplocystis*, in the Haemocoel of the Roach, *Blaberus craniifer* Burm., 126
- Habits of *Camponotus ulcerosus*, 82
Hydrovatus PENINSULARIS, 21
- Indo-Australian Species of the Ant Genus *Strumigenys* Fr. Smith: *S. wallacei* Emery and Relatives, 85
 Indo-Australian Species of the Ant Genus *Strumigenys* Fr. Smith: Group of *doriae* Emery, 160
- Larval Mites of the Genus *Eutrombidium* Attached to a Carolina Locust, 124
Leiradira ALTERNANS, 90
 Locust, 124
Lophomyrme quadrispinosus, 131
- Mantis religiosa*, 89
 Mecoptera, 28, 119
 Meloidae, 105
- Nemestrinidae (Diptera) of Iowa and Missouri, 14
Neopanorpa BAVIENSIS, 120
Neopanorpa CONTRACTA, 122
 Neuroptera, 114
 New Data on the Habits of *Cam-*

- ponotus* (*Myrmaphaenus*) *ulcerosus* Wheeler, 82
 New England Records of *Ululodes* Currie (Neuroptera: Ascalaphidae), 114
 New Neotropical *Chrysops* (Diptera, Tabanidae), 115
Notonomus MASCULINUS, 99
Notonomus SPURGEONI, 98
Notonomus TRIPLICATUS, 100
- Observations on the Reproduction of the Giant Cockroach, *Blaberus craniifera* Burm., 6
Oligomyrmex jacobsoni, 140
Oligomyrmex mjobergi, 140
Oligomyrmex parvicornis, 138
Oligomyrmex sundaicus, 140
Oligomyrmex thoracicus, 140
 On Flanders' Hypothesis of Caste Determination in Ants, 15
- Paedalgus infimus*, 146
Paedalgus termitolestes, 143
Panorpa CHIENSIS, 119
 Pheidologetini, 129
Pheidologeton affinis, 138
Pheidologeton diversus, 135
Pnyxia, 62
 Pterostichini, 90
- Reproduction of *Blaberus craniifera*, 6
- Setalis* SLOANEI, 92
 Some *Clivina* from Western Australia, 52
 Some New Diptera with Remarks on the Affinities of the Genus *Pnyxia* Joh., 62
 Some New Pterostichini, 90
 Some New Synonyms in Clytrinae (Coleoptera, Chrysomelidae), 148
Stenophilus ROTH, 38
Stenotabanus (*Stenotabanus*) CHIAPASENSIS, 45
Stenotabanus (*Stenotabanus*) LITOTES, 48
- Strumigenys bryanti*, 164
Strumigenys CLASMOSPONGIA, 2
Strumigenys doriae, 166
Strumigenys louisianae, 1
Strumigenys MIXTA, 4
Strumigenys nidifex, 85
Strumigenys OPACA, 86
Strumigenys PRODUCTA, 3
Strumigenys ULCEROSA, 162
Strumigenys wallacei, 85
- Tabanidae, 115
 Tabanidae from the State of Chiapas, Mexico, with Descriptions of Two New Species (Diptera), 41
 Taxonomic Notes on the Ant, *Camponotus cooperi* Gregg, 102
Teleonemia LUSTRABILIS, 151
 The Biology of *Euphasiopteryx brevicornis* (Townsend) (Diptera, Tachinidae), Parasitic in the Cone-headed Grasshoppers (Orthoptera, Copiphorinae), 69
 Three New Ants Related to *Strumigenys louisianae* Roger, 1
 Three New Species of Panorpidae (Mecoptera), 119
 Tingidae, 151
Trapeziopelta, 51
Trichosternus RELICTUS, 94
Trichosternus SOROR, 95
Trigonogaster recurvispinosa kemneri, 133
 Two New Oregon Chilopods of the Order Geophilida, 37
 Two New Species of Water Beetles from Florida (Coleoptera: Dytiscidae), 21
 Two New Tingidae (Hemiptera), 151
- Ululodes*, 114
- Water Beetles, 21
- Zelmira* WILLIAMI, 66

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